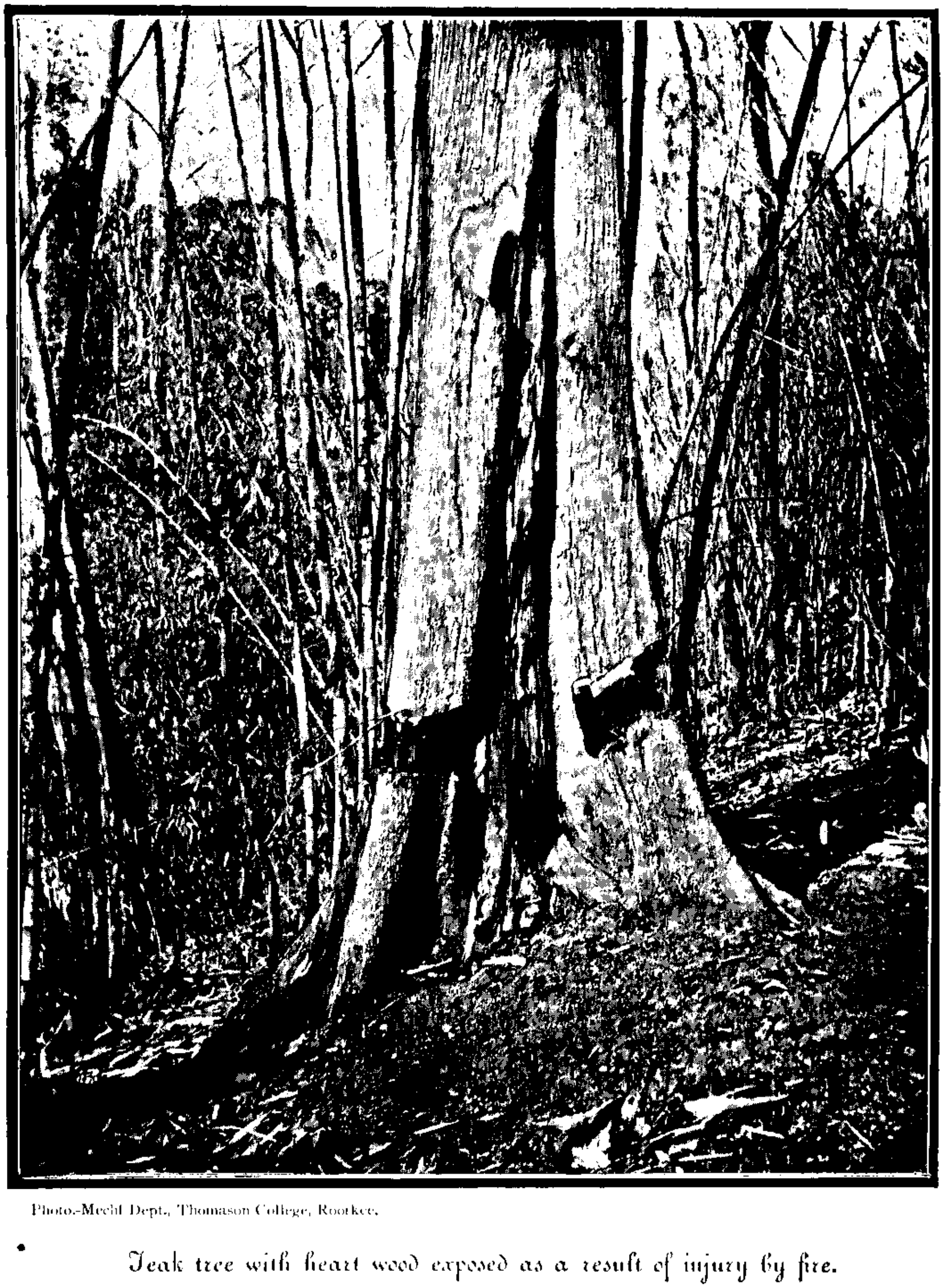

Photo.-Mechl Dept., Thomason College, Roorkee.

Teak tree with heart wood exposed as a result of injury by fire.

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THE MORTALITY FROM WILD ANIMALS IN INDIA.

The Resolutions issued annually by the Government of India dealing with the destruction of dangerous carnivora and snakes in India bear a strong resemblance to one another and from a scientific and economic point of view must be accepted with the proverbial *cum grano salis.* Any attempt at such a compilation in so vast a country as India, inhabited by races whose ruling tendency is certainly not a strong penchant for unbiassed veracity, must of necessity prove extremely superficial when it is remembered that the basis for the major portion of the material is collected by the village chowkidar.

Nevertheless the Resolutions are not without an interest of their own and serve a purpose owing to the fact that whilst detailing the mortality amongst human beings they recount the various steps taken in different parts of the country to deal with noted man-eaters. To some of these methods we propose to allude later on.

In the last Resolution* on the subject under consideration, the total number of human beings killed by wild animals in

* No. 2239-52, dated Simla, the 19th September 1906.

1905 is given as 2,054 as against 2,157 in 1904. Of this number wild elephants were responsible for 48, leopards for 401, tigers for 786, bears 88, wolves 153, hyenas 24, and "other animals" 554.

Of these animals the most serious are undoubtedly the tigers and leopards. Once these animals have acquired a taste for human flesh they rapidly become a scourge in the area they occupy, a reign of terror often setting in during which all work both in the field and forest comes to an end.

The usual procedure adopted by the authorities for the extermination of man-eaters is the time-honoured one, applied to all outlaws who devote their time to waging war against the human race, of setting a price on the head of the pest. Commencing with a small sum, a noted man-eater will often become so daring and engender such a state of terror in his "district" that his blood-money will reach the handsome figure of Rs. 500. Two such were killed during the year dealt with in the present Resolution, the one in Champaran and the other in Hazaribagh, both in Bengal.

In addition to placing a price upon the animal who has taken to man-eating propensities the civil authorities often issue special licenses to shikaris for the killing of definite prescribed animals. That such a procedure is advisable or in the long run even productive of any good result, we consider is open to considerable doubt. For instance, in the Mandla district of the Central Provinces twenty-six licenses were issued during the year to forest officials and police constables for the destruction of carnivora but the experiment proved a failure, its net result being the *wounding of two tigers*. Numerous other instances of the same procedure having been followed are quoted in the Resolution.

It is this aspect of the question we would wish to consider here.

Any one who goes in for heavy game shooting in India is well aware that the first necessity is a good rifle. Few of us would care to waste time and money in following or beating for dangerous game armed with no better a weapon than an old brown bess or an antiquated muzzle-loader. Without the best of luck in getting shots

and even with it how many animals would be wounded and how many brought to bag? And yet how were the majority of the 26 license holders in Mandla armed and what was the percentage of special license holders throughout the country who had any real chance of *killing* the game for the destruction of which the licenses were issued. It is a well-accepted fact that the majority of wounded tigers and leopards take perforce to cattle or man-eating in the first instance owing to their inability, in their maimed condition, of any longer killing deer and other wild animals which previously formed their natural food.

We do not think we are overstating the case when we say that the majority of tigers and leopards fired at and hit by native shikaris and others unsuitably provided with the proper weapons, escape wounded, and many a noted man-eater who, before coming to his end, has piled up a respectable score of human kills, has borne upon him the marks of previous wounds and not infrequently has turned out to be maimed. Is it not possible that the present methods in force for getting rid of a particular animal result in a direct increase, instead of the hoped-for decrease, of such pests? Would not the end in view be more surely attained by the introduction of an order that special licenses for the destruction of man-eaters should be only issued to those who were in the possession of suitable weapons and who it could be reasonably expected were able to make a proper use of them, and that rewards for animals slain *should be only paid to such!* The native shikari would then be more ready to help the properly armed sportsman to bag a noted man-eater instead of as now, endeavouring to put him off in the hopes of gaining the reward himself.

The passing of some order on the lines sketched above would be a first step in the right direction. It might prove possible however to take a further one and entirely prohibit the pursuit of tigers and leopards with unsuitable weapons. We are aware that a controversy could be easily waged round that word "unsuitable" by the advocates of the heavy as against the light rifle, but we think that all sportsmen will agree with us that neither the shikari's antiquated muzzle-loader nor the brown bess of the constable can

be considered to come within the term "suitable". The loosing off of such has in many cases practically amounted to culpable homicide since in innumerable instances it has been the direct cause of the subsequent slaughter of a long list of innocent victims taken from the ranks of the defenceless villager and wood-cutter. That there are difficulties in the way of the enforcement of such a law as is here advocated is obvious, but we believe that its enactment would lead to the better protection of the helpless native from that pest, almost as much to be dreaded as the man-eater himself, the insufficiently armed shikari who, from some safe perch in a tree, *makes the man-eater.*

We have not included in the above remarks the smaller carnivora such as the wolf and hyena which are much more easily destroyed. The campaign which has been waged in the United Provinces against the former animal has met with great success; districts like Budaun and Bijnor, formerly infested with these pests, being now declared practically free. In the Raipur and Bilaspur districts of the Central Provinces great success has also attended the operations against these animals.

Leaving the question of the Mammalia and turning to the Reptilia we see that 21,797 persons succumbed to snake-bite as against 21,880 in 1904. Orders were issued in Bombay for the supply to Government officers, institutions, municipalities and district local boards, of the lancets designed by Sir Lauder Brunton for the treatment of snake-bite with permanganate of potash. In the Central Provinces also a large number of lancets were distributed to vaccinators and selected land-holders. We would strongly advocate that the example so ably set by Bombay should be followed throughout the length and breadth of India. Amongst other centres at which the lancet should be procurable and where its use should be understood we would suggest the headquarters of every Range in the forests of the country. When the large population at work in the forests during the cold and hot weather months of the year is remembered and the utter impossibility in the majority of cases of any member of it bitten by a venomous snake being able to reach a town or local dispensary

in time, it is surely of the first importance to place within reach such a cheap means of saving life.

The destruction of cattle by wild animals would appear to be on the increase, or the returns are more accurately obtained, since the number rose from 88,206 in 1904 to 92,277 in 1905, whilst the number killed by snakes fell from 10,376 to 8,039. Of the former, the number destroyed by tigers amounted to 30,683 and by leopards to 44,845. And here we pause again and ask the question whether a part of this mortality is not also attributable to the insufficiently armed shikari who by wounding the tiger or leopard, perhaps but slightly though sufficiently to incapacitate it from procuring its natural wild *feræ*, sends it to prey upon the cattle of the unfortunate ryot!

There was an increase in the number of wild animals destroyed in the year (16,122 to 16,915), the numbers of the carnivora being respectively, tigers, 1,355; leopards, 4,811; bears, 2,236; wolves, 2,016, and hyenas 554. The rewards paid for the destruction of wild animals amounted to Rs. 1,27,665 as against Rs. 1,07,033 in 1904. The number of snakes killed fell from 65,378 to 64,117, the rewards paid being Rs. 2,676.

The number of licenses issued free of cost for the destruction of wild animals or the protection of crops during the year was 8,901 against 8,489 in 1904, the total number of licenses of this nature in force, including such as were valid from previous years amounted to 37,833 as compared with 37,720 in 1904.

The issue of such licenses is by no means an unmixed blessing to the ryot. We have seen that they may result, and do undoubtedly to some extent result, in the "making" of man-eaters. They also equally certainly lead to a greater destruction of cattle by the carnivora, since thousands of deer, the natural food of the latter, of all ages and sexes are ruthlessly slain by the holders of such licenses, in defiance of all laws and rules on the subject. The horns and flesh of such are to be found in every bazar in the neighbourhood of forest tracts.

If any real attempt is to be made to grapple with the man-eater and the cattle-lifter, we are of opinion it can only be in the

direction of a careful reconsideration of the gun license question, not only the would-be holder of such a license but his weapon being submitted to careful scrutiny before his license is sanctioned.

SCIENTIFIC PAPERS.

ON THE LIFE HISTORY OF TERMES (COPTOTERMES) GESTROI, WASM. THE HEVEA RUBBER TERMITE.

II.

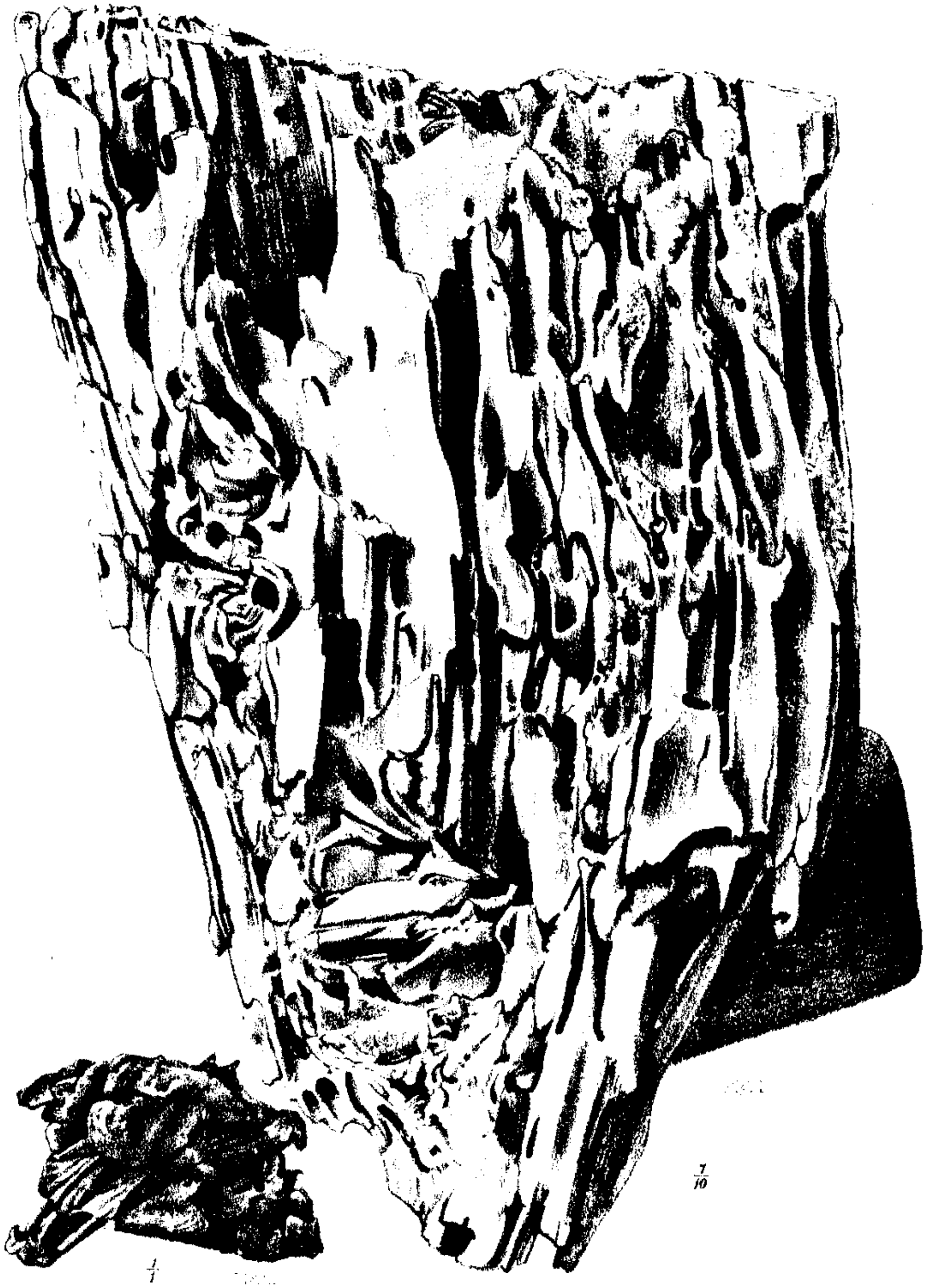
BY E. P. STEBBING.

In Volume XXXII (pp. 110—114) of the *Indian Forester* I made some remarks on the life history of the termite *Termes Gestroi* which is proving a pest of very considerable importance to the Hevea Rubber tree. My observations were chiefly, although not entirely, based upon a report of some investigations made by Mr. J. W. Ryan, the Manager of the Government Rubber Plantations at Mergui in Tenasserim. The paper was written with the hope of encouraging a further study of the habits of this pest with a view to obtaining a thorough knowledge of its life history. For without this latter it will not be possible to devise, with any certainty of permanent success, methods of combating its attacks. My remarks have evoked some criticisms from quarters where it is of the highest value, and also a certain amount of additional information on the subject of the methods of operation of the termite. Not the least important, perhaps, of this latter is the curious discovery made by my friend Dr. D. Hooper, Curator of the Industrial and Economic Section, Indian Museum, to whom I submitted, for analysis, some of the gum-mass formed in the interior of one of the termite nests.

Commenting upon my previous paper Mr. H. N. Ridley, Editor of the Agricultural Bulletin of the Federated Malay States, writes in the Bulletin * as follows :—

"The statement that the termite eats rubber seems highly "improbable and requires verification. Rubber is of course found

* Agric. Bull. Str. and Fed. Mal. Sta., V. 4, 110 (1906).



S.C. Mondul lith.

Fig. 1. Section of the crown of a root of a Hevea rubber tree showing the galleries of Termes Gestroi. Fig. 2. Portion of a mass of rubber taken from a nest in crown of root.

"in the hollow of the tree having *exuded inwards from the bark.* "The termites in ordinary trees bore from the hollow trunk "outwards and push through the bark, and in so doing in Para trees "doubtless cut into the lactiferous ducts and bleed the tree "inwardly; but is the statement that their bodies are full of latex "correct? The insect lives on all kinds of trees, many containing "no latex or resin of any kind, and it would be odd if it had "suddenly developed into a devourer of latex, still more if it eat "solid rubber. It exudes from its mouth a milky substance like "latex to defend itself as other species do. Can this have been "mistaken for latex?

"There is by no means always, if often, signs of withering in "a tree attacked before death..........."

Mr. E. E. Green, Government Entomologist, Ceylon, has the following criticisms in the Tropical Agriculturist* on the point that the termites collect and store the rubber in their nests :—

"This seems to me a most improbable explanation of the "facts, though, of course, there is nothing inherently impossible "in it. Being myself equally (with the author of the paper "in question) unacquainted with this particular termite in a state "of nature, it is with diffidence that I venture to put forward "what appears to me a more probable interpretation of the observed "conditions, namely, that the accumulations of rubber found "occasionally in the nests are the result either of a natural flow of "latex following upon the wounding of the tree by the termites, "or of the abnormal exudation due to a previously diseased "condition of the tree. It would be interesting to know whether "the supposed latex found in the bodies of the living insects was "tested and proved to be rubber latex It seems possible that "this statement may result from an error of observation. It is "well known that the 'soldiers' (the class most in evidence when a "nest is disturbed) of all termites, upon whatever they may have "been feeding, secrete a viscid milky fluid which they eject from "their mouths upon the least provocation. This fluid appears to "have some offensive properties to other insects and is certainly

* Trop. Agric. and Mag. Cey. Agric. Soc., New Series, XXVII, 1-85 (1906).

"a protective device. When ejected on to the human skin it "produces a reddish brown stain that defies soap and water for "many days..........."

Mr. Green is not quite correct in his surmise that I have never seen the insect in a state of nature. I have seen it in Tenasserim but had no opportunities of properly studying its life history.

As far as I am aware Mr. Herbert C. Robinson, Curator of the Selangor Museum, and author of the valuable paper entitled "Report on Termes Gestroi as affecting Para Rubber (*Hevea Brasiliensis*)" published no criticism on my paper. In a private and interesting letter he however wrote as follows :—

"To begin with there is no evidence whatever that the "termites feed on the latex though the idea is supported by the "fact that when annoyed they secrete a milky fluid resembling it "from a large foramen on the head which, however, is not latex.

"They do not collect and store rubber; it is undoubtedly "true that amongst the débris, etc., left by them in a tree whose "interior has been eaten away masses of rubber are found. These "however are due to the exudation of latex from the cambium "of the tree and not to the industry of the ant itself."

In a letter to Mr. Ryan I quoted the above criticisms, and in suggesting further observations I asked for information on the following points which were propounded by Mr. E. E. Green in his criticism above alluded to :—

(1) What proportion of the nests contain accumulations of rubber?

(2) What is the condition of such rubber? Does it appear to have coagulated in mass (such as would occur from a natural flow) or to have been built up—bit by bit—as would be expected if resulting from the individual collections of numerous insects?

(3) Has the milky fluid in the bodies of the insects the same reactions as true rubber?

I give below in full Mr. Ryan's reply.

"I read Mr. Ridley's criticisms in the Agricultural Bulletin. He states there that the termite in ordinary trees bores from the hollow trunk outwards and pushes through the bark. I send you a

Fig. 1. [illegible]

Fig. 2. Galleries in interior of wood.

5/12

S. C. Mondul lith.

Section of a stem of Hevea rubber tree showing attacks of Termes Gestroi.

section of the trunk of a rubber tree hollowed out by this termite, and you will see that after hollowing out the trunk (*vide* plate 3, fig. 2) the insects were engaged in working from the outside inwards; the surface of the bark is pitted with small shot-like perforations [plate 3, fig. 1 (*a*) (*a*)] and very few of these communicate with the interior.

From the size of the hollow in this specimen you will see that the termites have been for some time at work on this tree.

I had three young trees, 1 ft. to 2 ft. girth, on which the termites had just begun operations, dug up by the roots. The trunks and roots appeared perfectly sound, but the bark at the base and on about one and a half feet of the portion under ground was perforated by the ants; in this case they had begun working from the outside.

When a tree is attacked and the bark is riddled from the outside, one would expect to find the surface thickly coated with rubber, but this is not the case. A certain amount of rubber is found adhering to the outside of the bark, but this would naturally occur when the wound effect began to operate and the flow of latex was more than the ants could dispose of, and the natural conclusion is that the ants do either swallow or carry away the latex. The latex quickly becomes sticky and coagulates, and I do not see how they could continue their work if they did not dispose of the exudation in some way. A large number of animals and insects, too, I conclude, have developed a taste for the latex of rubber, and is it not possible that this termite has done so too! With regard to the withering of the tree noticed by me, this may be due to other causes. An attack by white-ants in the Straits is said to be preceded by a root fungus.

With regard to the question in your letter, I have found that what I took for latex being carried away is a secretion the ants eject when irritated by the breaking open of their galleries or when they are touched by hand. In one tree attacked by white-ants, having a circumference of 3 ft. 6 in. measured 3 ft. from the ground, I collected 6 lbs. of rubber. This tree was hollowed out from the crown of the root to a height of 7 ft. I cannot say what proportion the size of the nest bears to the mass of rubber collected.

The whole main hollow was filled with earth, and I do not know if this accumulation would be included in the nest.

With regard to the condition of the rubber found in the nest, I enclose a sample (see fig. 2, plate 2).

I have not been able to test if the milky fluid secreted by the ants has the same reaction as rubber latex; but if the ant swallowed the latex, would it not be digested before it was converted into rubber, and would the excreta contain rubber?"

I have had some illustrations prepared from the specimens alluded to by Mr. Ryan which he kindly forwarded to me. Plate 3, fig. 1, shows the hollowed out crown of the root, alluded to in my first paper, from which a mass of rubber was taken (*vide* fig. 2). The bark in plate 3, fig. 1 (*a*) (*a*), does not show the perforations very well, as it had dried considerably before the drawing was made.

I do not know that the question as to how the rubber, a specimen of which is shown in plate 2, fig. 2, accumulates in the interior of the tree can be considered as finally disposed of. The fact that it dries very quickly after exuding would seem to indicate a difficulty in assuming that it does exude, and presumably drip, inwards. Dr. Hooper's somewhat remarkable discovery, as detailed below, that this rubber is of exceptional purity must be considered as a point of considerable interest. In reply to my letter submitting a sample of this rubber to him for analysis Dr. Hooper wrote as follows:—

"The sample of Para rubber from the diseased trees in "Mergui has been examined and I find it to be of exceptional "purity as the following analysis will show:—

				Dry.
Moisture	...	...	1·44	...
Caoutchouc	...	...	96·70	98·1
Resins	...	...	·69	·7
Ash	...	...	1·17	1·2
			100·00	100·0

"The high amount of caoutchouc and the low amount of "resins indicate a rubber of great excellence. It would appear

"the insect agency has reduced the proportion of resins either by "consumption or by some chemical process of separation in the "crude latex. Whatever method has been at work the gum is of "much greater purity than any published analyses of commercial "Para rubber."

Mr. Ridley answers my question 8 (in the previous paper) in the affirmative, stating that the termites always work in the dark, repairing at once any damage to their tunnels by which light is admitted. In answer to question 12 he says that there is good reason to believe that the nest in the tree is connected with that in another. "I have seen a rubber tree attacked on the edge of a plantation and just opposite a tree in the jungle which had also been killed by them. Apparently the termites had tunnelled under the path, a fairly broad one, to the rubber tree. It was difficult to verify this accurately, as every one who has studied the underground termites knows how extremely difficult it is, if not impossible, to trace the small irregular passage they make from one spot to another."

Mr. Ryan gives some confirmatory proof of this fact. He writes: "In one case the ants had totally destroyed a Hevea. Three nests were found at the foot of the destroyed tree and they had tunnelled a gallery through a decayed root to the foot of another tree 15 feet away which they had attacked; at the foot of this freshly attacked tree two other nests were found."

On the subject of useful parasites attacking the termites Mr. H. N. Ridley writes: "I doubt very much the real value of the possible parasites on the termite as aids in combating it. My experience has always been that these parasites on social insects are far too scanty to make any appreciable impression on the community nor would it be possible to increase their numbers."

Mr. Robinson notes upon this point: "I have found numerous extraneous larvae in the nests, two carabids, several beetles of other unidentified families and a lepidopterous larva which appears to be a Lycaenid and is possibly a species of Gerydus, though I have not been able to rear it."

Mr. Ridley's remarks on the subject of parasites are, in view of Mr. Robinson's discoveries, perhaps unduly pessimistic. The

carabids certainly would seem to have been present in the nest having but one object in view—that of preying upon the termites. Should this prove to be the case, it might not be a difficult matter to introduce the beetles into areas badly infested with the termite.

I publish this paper because I think it contains some further points of interest and utility on the subject of *Termes Gestroi*.

ORIGINAL ARTICLES.

THE SOWING OR DIBBLING OF TEAK SEED IN BURMA.

BY J. NISBET, I.F.S. (RETIRED).

In the *Indian Forester* for October 1905, pp. 565–568, an article by Mr. Troup was published on "Teak-Dibblings: why are they a failure?" As no specific reply seems as yet to have been made to his question, I venture to think that some remarks by an older Burma forester may perhaps be not only of interest but also of use.

The portions of Mr. Troup's paper to which I would more particularly refer are the following:—

> For many years it has been the custom in some of the Divisions of Burma to carry out "dibblings" of teak seed in selected open localities in natural forest, with a view to obtaining teak reproduction artificially.
>
> These dibblings consist in depositing teak seeds in shallow holes in the ground and covering them lightly with earth. The soil is usually not prepared in any way, and the dibblings are as a rule carried out in June.
>
> In the vast majority of cases complete failure has resulted.
>
> * * * * * * * * * * * *
>
> The question of teak sowing in forest areas is a difficult one as well as a most important one; the operation has, however, so far as my experience goes, never met with much success. It would be interesting to know the results of other experiments bearing on the subject, or of cases, with details of the methods employed, where such sowings have been successful. So far it appears that our somewhat costly *taungya* system is the only one on which we can place reliance.

Such a pronounced opinion seems to me to convey a strong impression that the younger generation of Divisional and

Sub-Divisional Forest Officers in Burma does not study old records as carefully as they might well do, with no little advantage.

In this connection I should like to draw attention to what was one of the first, if not the very first, sowing or dibbling of teak seed made in Burma on any really extensive scale; and it was carried out in 1876, just exactly 30 years ago.

I may here note that I must write entirely from memory, and therefore cannot give precise details; but the indications noted are sufficient to serve for those who care to obtain all the information that it is now possible to get by searching in old records.

The only sub-divisional charge I ever held was North Tharrawaddy during the rains of 1876 in the first year of my service. In June or July of that year—for I recollect that it was long after the rains had set in at the end of May—dibbling of teak seed was carried out in Bwet (subsequently forming part of the Prome Division) by Forest Ranger Maung Kalé, in places where the bamboo (probably *D. strictus*) had flowered and died. In the Annual Report of the Additional Conservator of the Pegu Circle for 1876—as remarked, I write from memory only—this experiment was mentioned and was stated to be a failure. But in the Report for 1877 it was referred to again, with the remark that the young crop had come up. Either from the dibblings having taken place so late in the rainy season, or else from the seed having been poked in too deep in the muddy earth—or from the combination of both of these causes—the seed had lain over for a year and only sprouted during the second year (1877).

So far as I can recollect, the Ranger's report that the work had been carried out came to me some time during the month of August, after the Irrawaddy had reached its highest level, and while all the country to the south-west of Bwet (which means "marsh, swamp") was inundated. As it was impossible to get there by the plain—route open during the dry season—I tried to get up along the track of laterite skirting the hills. But the rivers, unbridged mountain torrents and timber-floating streams

were all in flood, and this route was therefore equally impassable. The inspection was consequently deferred till the end of the rains, by which time I had been transferred to another charge in the Sittang drainage.

It was not until January 1896 that ever I saw the results of these extensive sowings of 1876, when, as Conservator of the Pegu Circle, I visited that part of the Prome Division in the company of Mr. Branthwaite, the Divisional Officer. It was then, at 20 years of age, as successful as anything of the sort could possibly be. I think the only matter for regret was that a good many big trees had been left on the area when the dibbling operation was carried out. But the "Inspection Note" on this particular portion of the Bwet Reserve was filed in the Pegu Circle office, and a copy of it was also forwarded to the Divisional office. These should be easily obtainable, and they would give the actual girth measurements then made, as well as the description of the appearance and condition of these young woods about 11 years ago.

Even without being able to quote those Inspection Notes, I can safely assert that whoever sees these highly successful results of dibbling on a large scale will find it impossible to agree with Mr. Troup in saying—"So far it appears that our somewhat costly *taungya* system is the only one on which we can place reliance."

Although, as a Divisional Officer and afterwards as a Conservator, I pushed on the work of teak *taungya* planting as energetically as I could, yet I was never an enthusiastic admirer of this method of reproduction. I always felt that it was somewhat unnatural; for in place of furnishing family-groups of young teak, it yielded an unnecessarily large number of young trees per acre, all capable of asserting themselves—because of the marvellous amount of shade teak poles will stand from their own species without succumbing thereto. The vitality of young teak in this respect is indeed remarkable. This, however, was equally a fault in the Bwet sowings, as seen in 1896. Both in these and in *taungya* plantations the stock of about 1,200 an acre is a serious objection.

One has to plant close (6×6 ft. or 9×4 ft.) in order to obviate the heavy expense of cleaning and keeping down the rapid growth of weeds and creepers; but the result of such successful planting is that up till at least 20 years of age (my experience only went up to plantations of about that age when I left Burma in 1898), there is little or no natural process of self-thinning and gradual predomination of the individuals that will form the ultimate mature crop by means of those of more energetic growth forging ahead, dominating and suppressing the less energetic individual poles. The consequence is that at 20 years of age, when the young pole-woods have a height of about 75 to 90 feet, there are still close on 1,200 trees per acre, *all in active and healthy vegetation*, in place of having only, say, 600 to 700 of exceptionally energetic growth, with the rest already suppressed.

This is a very serious drawback, because it means that thinnings become necessary in order to give, artificially, assistance to the largest individuals by means of thinning, in order to provide a larger and freer growing space for their crown of foliage. And such thinnings must be rather expensive, as they have to be made before the smaller poles can prove marketable. To neglect them, however, seemed then to me to be "penny-wise and pound-foolish."

I do not know what has been done in this matter during the last ten years; but I recollect that in 1906 I found it necessary to order a regular scheme of thinning to be carried out in the older teak plantations in the Tharrawaddy and Rangoon Divisions of the Pegu Circle. The necessity for anything of that sort was never thought of in the early days of *taungya* planting, 25 to 30 years ago. It was expected that after one or two cleanings from weeds the plantations would grow up without any further expense than fire-protection.

The formation of teak plantations was in accordance with a definite policy ordered by the Government of India with regard to Burma early in the seventies (1871 or 1873, I think). I have always doubted very seriously that these plantations would produce such good, heavy and durable timber as the teak grown by natural

regeneration. It is, of course, even yet too early to arrive at a well-grounded opinion on such a matter, because we have no mature plantation-grown timber; but I could not help being struck even so early as in 1878 by the very noticeable difference in weight between similarly-sized sections of self-sown poles and of poles from our plantations. The wood of the former was heavier, *and therefore more durable.*

It always seemed to me that whenever the great flowering of the *Kyathaung* bamboo (*B. polymorpha*) might take place throughout the Pegu hills (an event that might have been looked for at any time during the last 10 or 15 years, seeing that the previous flowering occurred about 1853), the opportunity that would then be given of dibbling on a vast scale would render *taungya* plantations wholly unnecessary thereafter.

If, however, further observation should prove that the effect of fire-protection (as was suggested in the *Indian Forester* in 1905) is to produce the growth of suckers from *B. polymorpha* and *D. strictus*, then this may quite well result in no general flowering taking place; because nature always follows the line of least resistance, and if suckers can be thrown up she will not waste energy in seed production exhausting and killing the existing bamboo clumps.

Perhaps it may be of interest to note here that the most satisfactory *taungya* plantation I ever saw—that is to say, the one in which the final result (so far) most nearly resembled a series of natural family-groups in which the individuals of most energetic growth were rapidly developing into the predominating trees—was one in the Pyinmana Division examined by me in 1896-97, in the company of Mr. Reuther, then in charge of that Division. It had been considered a failure and had been written off the register of plantations, because of the excessive growth of weeds and the difficulty and expense of cleaning. But after being thus abandoned and receiving no attention for some years, it presented what seemed to me a more promising sylvicultural result than the closely serried grenadier-like lines of about 1,200 poles per acre, without any room for the best of them to spread out laterally. The details of this

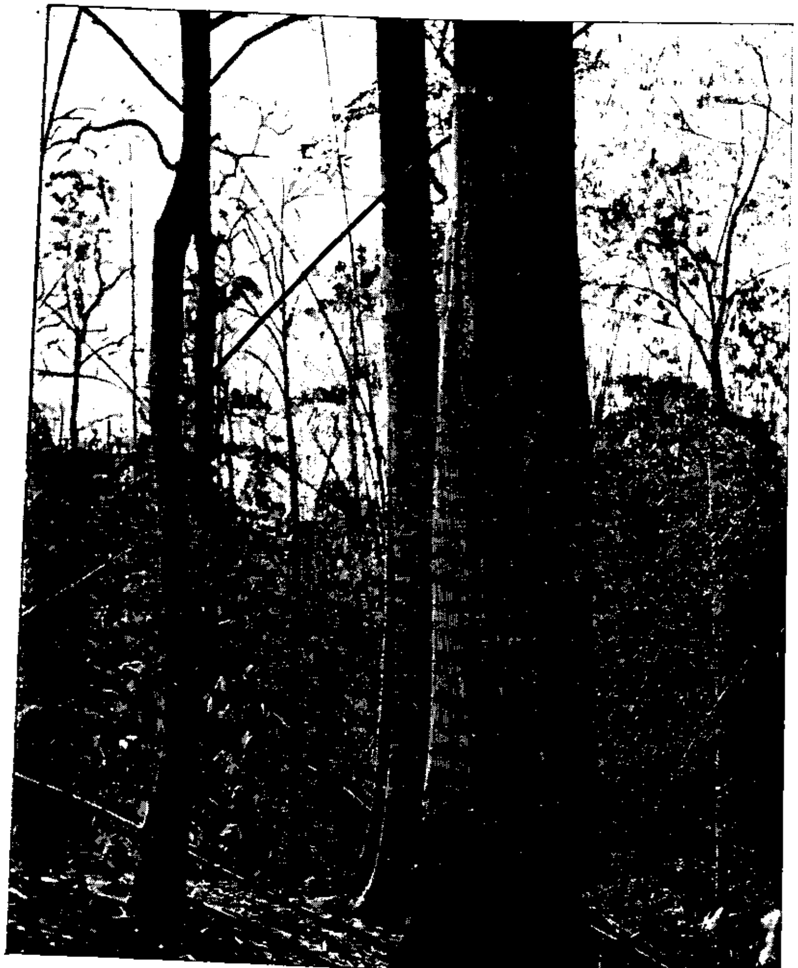


Photo. Mech'l Dept. Thomason College, Roorkee.

Fig 1.—Teak tree hollowed out as result of fire injury.

Fig 2.—Cavity in heart wood started by fires.

plantation can also be found in the "Inspection Notes" filed in the Conservator's office of the (then) Eastern Circle, and in the copy sent to the Pyinmana Divisional office. It would be interesting to know how this particular plantation now compares with the more regularly stocked plantations of the same age near it.

THE EFFECTS OF FIRE IN TEAK FORESTS.

BY H. RODGER, I.F.S.

In the *Indian Forester* for August 1904 the writer supplied some figures showing the damage done to old teak by fire in the Pegu Yoma forests of the Toungoo Forest Division obtained while girdling in 1900-01.

During the past working season, 1905-06, notes were made of the damage done to the teak trees which were girdled in compartments 47 and 48 Okkan Reserve, Rangoon Division. 1,103 trees were girdled of which 887 or 81 per cent were so much damaged as to have lost part of their commercial value, 135 or 12 per cent were damaged by fire but had, practically speaking, lost none of their commercial value, and 81 or 7 per cent were undamaged by fire.

These figures show a much larger percentage of damage than was found in the Toungoo Reserves which is explained by the greater dryness of the two compartments in the Okkan Reserve as shown by the large areas covered by *Dendrocalamus strictus* instead of *Bambusa polymorpha*, and by the proximity of these two compartments to villages and cultivation. They lie on the south bank of the Okkan Chaung, on the western edge of the reserve, and are much frequented by villagers and bamboo-cutters. Up to date they have not been protected from fire. The compartments in the Toungoo Division were more remote from villages and were not much visited by the people, even by the Karens of the neighbouring Karen area.

As examples of the damage done by fire some photographs, sent herewith, were taken of teak in the Okkan Reserve.

Plate 4, fig. 2, shows a young tree $3\frac{1}{2}$ feet in girth on a dry ridge. A ground fire among the bamboo leaves fanned by wind had in some previous year most probably killed the bark on a patch six inches high at the foot of the tree. In succeeding years the sapwood and then the heartwood rotted until now there is a cavity larger than a football.

The same plate, fig. 1, depicts a case in which the bark has been gradually burnt away for some feet up, and a long cavity in the centre of the tree, starting from the ground, has resulted, in addition to the external damage.

At the top of the tree may be seen a hole made by a bear, the heartwood being torn away in splinters 'to expose a bees' nest.

Plates 1 and 5, fig. 3, show the middle stage of damage resulting from fire. Near the ground are cavities of various sizes and the heartwood is exposed in the usual manner, as the result of successive fires, broad at the bottom and narrow at the top. Eight to ten feet at any rate will have to be sawn off the ends of these trees and left as useless when they are logged in three years' time, representing a loss of approximately Rs. 25 per tree.

In Plate 5, fig. 4, is seen a case where fire has ruined the tree which, although green, with a fairly good crown, is nothing but a shell If undamaged it would have provided a log about 5 feet in midgirth and 50 feet long worth at Rs. 80 per ton about Rs. 120, but after a long series of fires the top of the tree may be worth Rs. 10.

Nos. 2, 3, and 4 were girdled so that a log might be obtained from them before the damage increased.

The five photographs represent roughly what probably occurs during the history of a tree ruined by fire.

Photo.-Mechl. Dept., Thomason College, Roorkee.

Fig. 3.—Teak tree hollowed out at base as a result of bad fires

Fig. 4.—Teak tree with a green crown but the stem is a mere shell—result of frequent forest fires.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

INTELLIGENCE IN PLANTS.

In the *Monthly Review* S. Leonard Bastin, who is evidently a wanderer in what may be termed the by-ways of biological research and speculation, raises the question whether the beginnings of intelligence may not be traced in plants as well as in animals. "It is now," he says, "an established fact that plants can feel, in so far as the phenomenon of sensation is understood to be a response to external influence; this being so, there is," he contends, "nothing unreasonable should we go still further, and seek for evidence of something approximating to a discerning power in the vegetable world." The purpose of his paper is to set forth instances which seem to suggest the existence of such a power. They are, he tells us, in all cases either the outcome of personal observation or gathered from the records of indisputable authorities.

Among the strange plants which have developed carnivorous habits are the Droseraceæ or Sun Dew group. Indigenous species are found both in England and in America. "The leaves of all the members of the family are densely covered with clubbed hairs, and a fly settling amongst the tentacles is immediately enclosed by these organs; meanwhile, a peptic (*i.e.*, digestive) fluid is exuded from the glands of the leaf. An interesting experiment may be conducted with the Sun Dew, proving that the little plant has a certain discriminating power. Place a tiny pebble amongst the tentacles; these at once close in, it is true; but not the least attempt is made to put out the digestive liquid. How does

the Sun Dew know the difference between the fly and the pebble?" A few years ago Mrs. Treat, an American lady, proved that the leaves of the American Sun Dew were actually conscious of the proximity of flies without any direct contact. She pinned a living insect at a distance of half an inch from a healthy leaf. In about a couple of hours the leaf had moved near enough to secure its prey by means of its tentacles.

The Venus Fly Trap (*Dionæa Muscipluа*) of South Carolina belongs to the same natural order as the Sun Dews. Its leaf consists of two bristle fringed lobes hinged together. On the upper surface of each lobe are three sensitive hairs. When any object touches one of them the lobes snap together, and the catch is imprisoned. The leaf will enclose anything, a small piece of cinder, for example, but it does not take it long to find out if its capture is inedible, and in that event it soon opens to release it. A fly or a bit of raw beef, on the other hand, is tightly clenched, until after an interval of several days it is drained by the plant of the desired nitrogenous food. How, asks Mr. Bastin, can you explain the behaviour of the Dionæa without admitting the presence of some discerning power? Even roots are cited as illustrations. The aerial roots of tropical Lianes, growing under artificial conditions, have sent out their organs to a tank 25 feet beneath, "evidently," says Mr. Bastin, "with the knowledge that they would find water at the end of their journey."

A most remarkable example of the relations established sometimes between plants and insects is supplied by a central American acacia (the *Spherocephala*). "This tree grows in districts where leaf-cutter ants abound, and where the ravages of these insects are so dreadful that whole areas of country are at times denuded of foliage in a few hours. The acacia has, however, hit upon a unique way of protecting itself against the assaults of these enemies. At the end of some of its leaves it produces small yellowish sausage-shaped masses, known as 'food bodies.' Now these seem to be prepared especially for the benefit of certain black ants, which eat the material greedily, and on this account it is no matter for surprise that these insects (which are very warlike in habit) should make

their homes in the acacia, boring out holes in the thorns of the tree to live in. At the approach of an army of leaf-cutting ants the hordes of black ants emerge, fired with the enthusiasm which the defence of a home is bound to inspire, with the result that the attacking enemy is repulsed and the tree escapes unscathed."

EXTRACTS FROM OFFICIAL PAPERS.

NOTE ON THE BANDA FORESTS.

I.

The first step towards acquiring on behalf of Government the land that now forms the Banda Forests was an inquiry into the extent and character of the waste lands, initiated by Government in 1877. As a result of this preliminary inquiry a notification was issued (No. 761 of 6th December 1878) under section 35 of the Forest Act (VII of 1878), and the then Collector of the district (Mr. McConaghey) was directed to submit definite proposals. This he did on the basis of inquiries made by him during the cold weather of 1879-80 (see Collector's No. 2-F. of 5th February 1880 and subsequent correspondence). It was decided to acquire forest rights in 32 villages, all, with the exception of Kulhua in pargana Badausa, situated in pargana Karwi.

2. Mr. McConaghey's original proposals resulted in the acquisition of proprietary right in the whole or part of the area that it was decided to take up as forests in 13 villages. As regards the areas required in the other villages he settled with the zamindars the agreement given below which to this day governs the status of the forests in which proprietary right has not yet been fully acquired, and which are known from the method of division of profits set forth in Clause III as the "pachpan-paintalis" forests.

Agreement.

I. The lands within the forest line demarcated by the Collector, whether cultivated or uncultivated, shall from and after this date pass into his management, our proprietary rights remaining intact as before and all arrangements in connection with cultivation

cutting or selling wood, etc., shall be made by the Collector without interference on our part.

II. The entire arrangements for the collection of the revenue of every description from the lands, trees, and forest produce such as honey, gum, catechu, iron, lime, etc., within the forest circle shall be made by the Collector.

III. After payment of all expenses of collection, supervision, etc., the profits shall be divided between Government and the zamindars, the former receiving 55 and the latter 45 per cent.

IV. In case of a dispute between us as to the amount due to each village the decision of the Collector shall be final.

V. No lands inside the forest circle shall be broken up or cleared for cultivation or cultivated without the written permission of the Collector or of some one duly authorised by him to grant such written permissions.

VI. The rates of rent for lands within the forest circle cleared, broken up and cultivated by permission of the Collector shall be fixed and the rent collected by him. The ryots shall have the advantage of the same rates as those fixed for the zamindars.

VII. Until the giving out of the new jamas by the Settlement Officer we zamindars shall pay the demand now in force after which the lands within the forest circle shall be excluded from the area assessed by the Settlement Officer but shall be liable to rent fixed by the Collector as per Clause VI.

VIII. In the case of mauzas Chaunri and Chalha, the whole of whose area is included in the forest circle, the present settlement shall cease with the conclusion of the present year 1287 F. after which these villages shall be held under direct management and the profits payable to the zamindars shall be 45 per cent of the income after deduction of expenses of management, collection, supervision, etc., as per rule III.

IX. The zamindars and residents of the village are entitled to graze their own cattle free from all charges as before. All others will pay at the rate of one pice per head of cattle per season.

X. Zamindars and ryots are entitled to wood for fuel and to wood and bamboos for agricultural and domestic implements,

erection and repairs of houses, cattle-pens and such like purposes, but they shall not cut down or remove any tree or wood for such or any purpose without the consent of the Collector or a Forest Officer authorised to give such permission.

XI. Mahua.—The rights of zamindars and ryots to collect the mahua flowers from the trees inside the forest circle remain as heretofore. Government does not claim rent from the trees or a share in the fruit.

XII. Tendu and Ber.—The fruits of the chironji, tendu and ber trees are free to all residents in the villages for their private consumption, without payment of any dues, but if they desire to sell any of their products the chironji kernels shall be first offered for sale at a Government godown and tendu and ber fruits shall be subject to such rent as shall be decided upon by the Collector.

XIII. *No dues from catechu-makers,* lime-burners, iron-smelters and the like shall be collected by zamindars from after the date of the signing of this agreement, as after it the provisions of Clause II shall come into effect.

XIV. If at any time Government shall withdraw the restrictions now imposed on the forest lands which have been separated from our villages we, the present zamindars and our representatives, shall retain the same rights as we had before this agreement was made.

XV. Any zamindar or resident of the village who violates any condition hereby agreed to is liable to be excluded from all or any of the privileges mentioned in this agreement at the discretion of the Collector provided that this section shall not be held to affect any punitive section of the Forest Act or bye-law sanctioned by Government.

XVI. After the expiry of five years Government has the right to modify and alter any of the foregoing rules.

The only change in this agreement that has since been made under the powers contained in Clause XVI is that the rate at which grazing is permitted for outside cattle has been assimilated to that in force in the Reserved Forests and any order affecting the one applies to the other in absence of any definite intimation to the contrary. Any opportunity of acquiring proprietary right in these

areas held under this agreement is taken provided that the owners are willing to accept a reasonable price, but in view of the fact that the agreement gives complete control over the forest it is considered unnecessary to acquire against the will of the present proprietors under the Land Acquisition Act. The forests are known to the Department as "Unclassed".

In accordance with the above-noted policy as regards purchase full proprietary right in several more portions of the forest area have since been acquired, and the following table will show the date and method of acquisition of all areas in which full proprietary right has been acquired and the areas that still remain managed under the agreement :—

Mauza.	Area in which proprietary right acquired.	Area held on the 55/45 terms.	Date of acquisition.	Method of acquisition.
	Acres.			
Mau ...	386	...	22-4-80	Reduction of land revenue till next settlement.
Unchadih ...	414	...	28-3-80	Do.
Sakrohan ...	645	...	28-3-80	Do.
Ranipur-Kalyangarh ...	2,698	...	14-1-81 8-12-81 12-2-82 18-2-82	Purchase and exchange.
Khatanta-Mamaniyan ...	2,250	...	8-12-81 2-2-72 18-2-82	Purchase and exchange. Half the produce of the mahuas goes to ex-proprietors in perpetuity.
Rajanhan ...	4,619	...	17-11-80	Purchase.
Deori ...	4,273	...	26-3-80	With Kulhua by exchange for the muafi right in Bhuinhari from Mahant Madho Dass.
Gidarha ...	222	...	14-1-81 2-2-82	Purchase and exchange.
Uldan ...	714	...	3-1-81 8-12-81 18-2-82	Do.
Nihi ...	...	2,110	...	...
Mahuli ...	...	949	...	...

Mauza.	Area in which proprietary right acquired.	Area held on the 55/45 terms.	Date of acquisition.	Method of acquisition.
	Acres.			
Kalyanpur ...	...	2,671	...	...
Karauhan ...	...	728	...	...
Shekhapur-Chitghati ...	...	69	...	...
Jaro ...	1,140	.	26-3-80	By exchange for muafi of Cherriya Khurd from Mahant Janki Dass.
Chaunri ...	4,037	...	6-3-80	Perpetual lease.
Chulha ...	1,592		5-12-89 / 17-2-91	Half by purchase, half by perpetual lease
Kulmar Parasin	3,623	..	7-3-80	By exchange for muafi in mahals Chua Ram and Ram Dass of mauza Khunyan.
Donda ...	5,416	...	31-3-80	By exchange for muafi at rest of mauza.
Gursarai ...	...	908	...	...
Tikariya Jamanhai ...	...	2,892	...	...
Dadri ...	...	4,697	...	...
Bhenda ...	778	...	26-9-89	Purchase.
Amehurnarwa .	4,217	...	6-3-80	Perpetual lease. Ex-proprietor retains right to produce of all mahuas.
Rukma Khurd ...	133	...	9-4-80	Purchase.
Karka ...	731	...	1-4-80	Do.
Chheriya Kalan	1,238	...	2-2-82 / 20-2-82	Purchase and exchange.
Ambha ...	2,243	...	26-3-80	Perpetual lease.
Cholhi ...	1,667	39	30-3-80	Purchase.
Matdar ...	6,729	...	10-3-80	Do.
Rukma Buzurg...	...	1,978	...	...
Manreyan Kalan	...	1,886	...	...
Kulhna ...	6,182	...	26-3-80	As noted under Deori.
Total ...	55,816	18,928	...	

The whole of mauzas Rajohan, Deori, Chaunri, Chulha, Bhenda, Ambha, Matdar and Kulhua have been acquired and their names therefore disappeared from the lists of revenue-paying villages of the district. As will be explained further on, there are in some of them areas excluded from "reserved" forest managed as Government estates. As at the time of acquisition the revenue and therewith the cesses on the areas acquired were abolished, these areas were withdrawn from the patwari circles in which they then were, and there were no patwaris, and consequently no records, for the acquired areas including the "excluded" areas until their retransfer to the Collector in 1896.

(To be continued.)

MISCELLANEA.

XV.—THE CHIEF TIMBER TREES OF INDIA.

BY J. NISBET, D. ŒC.

I.

In such a vast country as India, extending over about 40° of longitude and 20° of latitude north of the equatorial line, there is of course a great variety of climate, and consequently also of botanical regions, each characterised by its own peculiar flora. There are vast tracts, larger than some of the countries in Europe, which have an arid and in some years almost a rainless climate, as in Sind, Rajputana, and portions of Central India and the Punjab; while towards the extreme east the notorious Cherrapúngyi, situated in a bend of the mountains which catches the moisture-laden southern monsoon winds and cools them down, has the largest known rainfall in the whole world, an average of 640 inches, or $53\frac{1}{3}$ feet a year. And when to this enormous variation between the extremes of drought and of moisture are added not only equal, but also even greater variations and extremes of heat and cold, ranging from the eternal snows of the great Himalaya Mountains to a temperature often about 115° to 120° in the shade during the hottest time of the year, it can easily be understood that tropical,

sub-tropical, and alpine India offers, as Sir Joseph Hooker remarks in the introduction to his *Flora of British India*, perhaps the richest, and certainly the most varied botanical area on the surface of the globe. And elsewhere he estimates that the Indian flora includes about 15,000 different species of plants.

As might of course be expected with such a general wealth of flora, the typically forestal vegetation likewise shows great variations, and occurs in vast abundance in most parts of the country which are not thickly populated. There has as yet been no general botanical survey of the trees, shrubs, and woody climbers which are to be found in the forests and jungles; but in the introduction to the second edition of his *Manual of Indian Timbers* Mr. Gamble estimated that there are about 4,749 known species actually indigenous to India, including 2,513 trees, 1,429 shrubs, and 807 woody climbers. It may, perhaps, give some idea of this enormous botanical wealth and variety, when it is stated that there are only 134 species of woody plants in the British Isles, so that the Indian forest flora is at least 35½ times as rich and varied,—and probably much more so, because many of the wild and unadministered forest regions of Farther India have not yet been examined.

Among all this wealth of woody fibrous plants about 1,450, including exotics, have been described in Gamble's *Manual* with regard to their general appearance and the character of their wood. But what may be termed the chief timber-trees of India consist of about thirteen kinds, a baker's dozen (teak, sál, deodar, sissoo, babul, juniper, khair or cutch, blackwood, sandal-wood, red sanders, and the three ironwoods—pyingado, nahór, and anján), while a fourteenth, the *mahua* of Central India, though also yielding excellent timber, is of much greater value for its flowers, the sweet and fleshy corollas of which form an important article of food through the local forest tracts.

In point of actual monetary and mercantile value the TEAK TREE (*Tectona grandis*) is *facile princeps* the most important of all the forest trees in India. Its moderately hard, golden-brown wood, which darkens considerably with age, is easily recognisable

from the strongly-scented essential oil to which this timber owes its special suitability for ship-building--an oil which preserves steel and iron, in place of corroding them like the tannic acid contained in oak. The finest development of the teak tree is attained in the mixed deciduous forests of Burma, whence about one and a half million pounds' worth of this timber is annually exported. But it also occurs scattered throughout the dry forests in many parts of the Central Provinces and Madras and on the Western Ghâts in Bombay. It was from these Madras and Bombay forests, situated conveniently near the coast for shipment to Bombay, that considerable supplies of this fine timber were first of all obtained for local ship-building, and then for export for the use of the English navy, about a hundred years ago, when the existing stock of home grown oak had become almost exhausted, and when the national outlook for ship-building timber, during the time of our continental war, had reached its very gloomiest stage. It seems to thrive best in places with a mean annual temperature of between 70° and 80°, with a definite alternation of wet and dry seasons of the year, and without extremes of heat and cold. It is not exacting as to soil or aspect, so long as the drainage is good. Teak is not a truly gregarious tree, but is usually to be found associated with many other deciduous trees growing above an underwood of bamboos. It seeds freely, and germinates fairly well in clear places ; but, unless artificially protected, the seedlings which come up are for by far the most part either choked by young bamboos or weeds, or else are burned down year after year by jungle fires. Thus in fire-swept areas, where jungle fires run over the ground every year some time during the hot season lasting from the middle of March to the middle of May, young shoots are thrown up time after time for ten to twenty years, and sometimes more, until at length a stronger growth or some happy chance enables them to shoot upwards and assert themselves in future. In the Burmese forests the association of teak with bamboos is taken advantage of to make sowings at the periodical flowering and dying off of the bamboo undergrowth, at intervals varying from 15 or 20 to over 50 years, according to the kind of bamboo, because it is only

then that the seedlings can be expected to have any chance of getting their heads up high enough to escape being outgrown and suffocated by the young bamboo shoots thrown up in ever greater lengths year by year unless checked by shade overhead. Plantations are also largely formed to provide larger supplies in the future; and, besides this, much assistance is given in the way of protecting large forest areas from jungle fires, and of killing inferior species of trees by "girdling" or ringing them into the heartwood in order to increase the proportion of teak. It has a strong upward growth and a marked tendency to clean itself spontaneously of side branches, even when not grown in close canopy; and in plantations it runs up straight as a plummet-line to a height of about 75 to 80 feet in the course of 15 to 18 years. Working-plans have been introduced into all the chief forests in Burma to determine the number of mature trees that can be cut in each during the next 30 years, so that there may be no danger of over-working any tract; and it has been found that, on the average, it takes a teak tree from 150 to 180 years of age to attain the mature marketable size of 7 feet in girth, measured at 6 feet above the ground, the rate of growth being of course quicker in the fairly moist than in the very dry forests. The investigations made in order to arrive at these practical conclusions showed that, while the average rate of growth is about 12 annual rings per inch of radius (a rate often equalled and even exceeded in the case of our own oaks and other hardwoods), the average age of a 3 feet tree is 68 years, and that after this it takes other 29 years to reach 4½ feet girth, 35 more to attain 6 feet, and other 27 to reach the fully mature girth of 7 feet. Under favourable circumstances teak attains very large dimensions. In the Kyaukmasin forest in Burma, 26 years ago, I measured several huge, but usually rather stunted, trees varying from 20 to over 24 feet in girth at 6 feet up; and gigantic logs have been floated out having the fine dimensions of 64 feet by 13¾ feet mean girth, and 82½ feet by 10 feet mean girth. When quite fresh, teak timber is hardly floatable, but after being "girdled" and allowed to season on the stool in the forest for two or three years it is easily raftable. Although some of the

finest forests have of late years been overworked, the measures taken for the protection of this splendid timber are such as to secure not only the continuous maintenance, but also largely increased supplies of it in the future.

The SAL-TREE (*Shorea robusta*) occupies, like the teak, two of the distinct forest regions of India. It grows more or less gregariously in the form of a belt skirting the base of the Himalayan range, and clothing the valleys and lower hills to a height of 3,000 to 4,000 feet, while it also occurs similarly in Central India, extending from the Central Provinces into Rewa, Orissa, Jeypur, and Vizagapatam. It is a very hard, heavy, coarse and cross-grained timber of great durability, though it is a very difficult wood to season owing to its liability to warp and split. But as regards durability, strength and elasticity, well-seasoned sál is perhaps the finest of all the Indian timbers—except, perhaps, the pyingado or ironwood of Burma. It is chiefly used for railway sleepers, though also largely employed for general constructive purposes, such as bridges, piles, beams, etc. As it is not floatable, difficulty is experienced in extracting it in large logs from the forest. It is usually found growing on shingle and sand, or on loam resting on gravel. As it produces seed abundantly, and as the seeds ripen just at the beginning of the annual rains and germinate readily, the large-leaved and shade-bearing seedlings soon manage to choke all other seedling growth and to assert themselves gregariously. The young seedling crop, however, usually disappears year after year, either in consequence of frosts by night or of sun-scorching by day, while jungle fires kill them wholesale unless the area be specially protected; and it is not until after some years when the roots have penetrated down to a permanently moist subsoil that the young plants are able to assert themselves against this annual dying down of the shoot. The finest growth of the sál is attained near the foot of the Nepál hills, where trees grow to between 100 and 150 feet high, with a clear stem of 60 to 80 feet and a girth of 20 to 25 feet. Climate and soil of course cause considerable variations in the rate of growth of this as of other trees; but it has been found that it usually takes

from 80 to 100 years to reach a girth of 6 feet, and consequently a rotation of about 100 to 120 years has been adopted in the forest working-plans. Protection against fire, and improvement-fellings to replace badly-grown stems by those growing under more favourable circumstances, and to reduce the proportion of inferior species throughout the crop, are the chief measures taken by the Forest Department to preserve and increase this very valuable timber; and no doubt the effect of these measures will be to largely increase the available supply for future generations.

The DEODAR or "GOD'S TREE" (*Cedrus libani* var. *Deodara*), the most important and valuable of the Northern Indian timbers, furnishes a light, moderately hard, strongly scented and oily wood of a pale yellowish-brown colour. It is chiefly to be found in the western Himalayan regions, at an elevation of about 6,000 to 8,000 feet, whence it extends to the mountains of Afghanistan. Except in the case of sacred groves around temples, and in some parts of Kumaon, the Punjab, and Kashmir, it is rarely to be found growing gregariously and forming pure forest; because it usually occurs in family groups interspersed among its characteristic associates, the Himalayan spruce (*Picea morinda*), the blue pine (*Pinus excelsa*), three kinds of Himalayan oaks, and sometimes the Himalayan silver fir (*Abies pindrow*), cypress and yew, and the long leaved pine (*P. longifolia*) at lower elevations. But, besides these more frequent kinds of trees, the deodar forests contain a rich variety in the Indian birch, poplar, horse-chestnut, elm, hazel, maple, cherry, holly and rhododendron, together with an undergrowth of shrubs closely related to many kinds common in different parts of Europe. Two well marked varieties of deodar grow in those forests which are said to run true to seed. One of these has a dark green, and the other a silvery foliage; but the latter is comparatively infrequent and is chiefly to be found at the foot of low-lying ravines. The deodor has naturally a spreading and very beautiful habit of growth, and unless this expansive tendency be checked it soon runs into branches instead of forming the clean, straight bole desirable in a timber-tree. In the close canopy of the forests the deodar seeds rather sparsely, and the best seed-bearers are those

occupying sunny spots on ridges, whence the winged seeds are wafted for some distance by wind, when the cones break up and drop their scales during warm dry weather in the months of October and November, about a year after the flowering. The male and female flowers are sometimes, though not usually, found on the same trees, but a really good seed-year only occurs once in four or five years. On these occasions, in suitable localities, the growth of young seedlings is abundant and rapid, unless they are choked by rank grass and weeds, or checked in growth by severe drought, cattle, or forest fires. They can bear a fair amount of shade, though it is best to assist their development by means of lopping branches and girdling trees of inferior kinds. In order to produce the best class of wood for railway sleepers, it has to be kept in fairly close growth, and careful thinnings can only be made when once it has completed its main growth in height. The rate of growth and the dimensions attainable vary greatly in different localities. In the corridor of the Imperial Forest School at Dehra Dún there stands a magnificent cross-section of a Kumaon deodar, 23 feet in girth, and showing 665 annual rings. Numerous trees have been found between 30 and 36 feet in girth, but the largest known is one at Kuarsi, in the valley of the Ravi river, measuring 44 feet in girth at 2 feet and 36 feet at 6 feet up: while heights of 216 and even 240 feet have been recorded. Even in good localities, however, the tree is at its best for timber when it reaches about 12 feet in girth, while in less suitable situations its maturity is attained at about 9 to 10 feet. Under the forest working-plans the average girth of the mature trees may be taken as between 7 and 8 feet, attained at an age of 140 to 165 years, while the average number of narrow-gauge sleepers converted from each such tree varies from 50 to 70. The chief means of maintaining and increasing the supplies of this very valuable timber-tree is to cut out a large number of the other trees, or to kill them by girdling if not marketable, and work up the soil; and after a good seed-year has produced a rich crop of young seedlings, the whole of the area is graduaily cleared and blank spaces filled up, so as to leave immature trees and the new crop—a procedure which of course

requires to be varied according to the given circumstances. Being light, the timber floats well; and most of the deodar logs brought out from Kashmir and the Punjab, and the sleepers worked out from the Tons and Jumna valleys in the United Provinces, are drifted or rafted down the streams.

The SISSOO or SHISHAM (the "Shittim" wood of the ancient Jews, *Dalbergia sissoo*) grows gregariously in the river-beds of streams and on the sandy or stony banks of torrential rivers all along the sub-Himalayan tract and the valleys up to 3,000 feet from the Punjab to Assam, whereas elsewhere it sows itself only sparsely throughout the plains of Upper India. Its very hard, close-grained brownish heartwood, streaked with dark longitudinal veins, does not show the annual rings at all distinctly; but it is a decidedly ornamental wood which seasons well without warping or splitting, takes a good polish, and is admirably adapted for carving as well as for all purposes where strength, toughness and durability are demanded. In furniture and carving, indeed, it is one of the finest woods in India, being perhaps rivalled in this respect only by its very near relative the blackwood (*D. latifolia*). Though it reaches a height of about 60 feet or more, it does not run up in a clean straight stem, but is often buttressed, gnarled-like and twisted, so that it seldom can be got to yield good straight logs. It is of rapid growth at first, but soon decreases to a slower rate. It does not usually grow to more than about 6 feet in girth, although occasional stems of 10 and 12 feet near the ground are not altogether uncommon. Even when growing gregariously, the Sissoo trees bear an exremely light crown of foliage; and being exceedingly light-demanding, it soon thins itself gradually during the pole stage of growth. The pure or almost pure patches of Sissoo forest to be found on the sandy river-bed lands of Upper India are formed from seed washed down in the pod while the streams are in flood. As the pods are indehiscent, they gradually rot away till the seed is enabled to germinate, and the young seedling utilises most of its energy at first in forming a long tap-root of about 6 feet in length, which fixes it in the soil and prevents its being washed away during the floods of the following year. As the sands

become deposited here, this gradually raises the level of the ground and forces the water to deepen the channels alongside, so that the young crop gradually rises above the surrounding water-level and occupies separate islands or terraces. On suitable soil Sissoo can easily be grown from seed, although it is a difficult tree to transplant owing to its long root-strands. It is a prolific seed-producer, and seeds itself easily, while its natural reproductive power is often increased by a free production of root-suckers. Under favourable circumstances it attains a girth of 30 inches in 12 years, and 54 inches in 30 years, representing respectively $2\frac{1}{2}$ and $3\frac{1}{2}$ annual rings per inch of radius; but in the celebrated Changa-Manga plantation, formed by irrigation with canal water near Lahore, many of the trees averaged 4 feet in girth at 12 years of age; while in the natural forests in Oudh an average girth of 36 inches and a height of 50 feet is attainable in 16 years, or at the rate of 1 inch of radius in $2\frac{2}{9}$ years. As in the case of all the other more valuable timber-trees, much is being done to increase the supplies required for future use.—*Transactions of Royal Scottish Arboricultural Society.*

(*To be continued.*)

LEGAL INTELLIGENCE.

STRAYED ELEPHANTS.

A CURIOUS ASSAM CASE.

AN important and very curious case has just been decided by Mr. W. B. Brown, Judge of the Assam Valley Districts. It came up in the form of an appeal from the Deputy Commissioner and Sub-Judge of Sibsagar, and the question at issue was the ownership of an elephant originally wild, which had been tamed, but afterwards lost in the jungle, where it was recaptured by the defendants, who are lessees of an elephant-catching mahal from the Government. The Sub-Judge held that property in the elephant remained with the plaintiff, and this decision was appealed against, but was upheld by the District Judge. In the judgment there is an

interesting discussion of the law as to property in animals. After quoting a passage from Blackstone, Mr. Brown says :—

The passage from Blackstone is merely a condensation from the Institutes of Justinian, where the subject is treated at greater length. In England the question has only an academic interest, for wild animals kept in actual confinement are protected by a special statute, and the only other wild creatures of any value are game, birds and beasts, which are very efficiently protected by the Poaching Acts, although by a legal fiction the poacher is punished, not for shooting game but for trespassing on somebody else's land in order to shoot game. It is a curious circumstance that the principal authority on a subject of great importance to the Assamese people should be that of a Roman Emperor. The subject is treated in Book II, Tit. I, Sections 12 to 15 of the Institutes. Justinian begins by saying that " Wild beasts and birds and fishes, that is, all animals which may be born in the earth, sea and sky, by the law of nations belong to their captor as soon as he catches them ; for as they were nobody's property before, it stands to reason that they must belong to the person who seizes them. Such an animal is considered to be yours only so long as it remains in your keeping, for if it escapes from your keeping and returns to its natural liberty it ceases to be yours, and becomes the property of the person who next catches it. It is understood to have recovered its natural liberty when it has either gone out of your sight, or, although you still see it, you cannot easily catch it."

* * * * *

Justinian holds that bees, peacocks and pigeons are animals *feræ naturæ*, and it makes no difference that they are accustomed to fly away and come back, for some people have deer also so tame that they are used to go into the woods and come back, and nobody can deny that deer are of a wild nature. He says " As to all those animals which are accustomed to go away and come back I approve of the rule that they may be held to be yours as long as they have a mind to come back (*animum revertendi*); for if they cease to have a mind to come back they cease to be yours and belong to their captors. They are seen to have ceased to have a mind

to come back when they have ceased the custom of coming back."

* * * * *

As to the application of these doctrines to the present case, it should be remembered that Justinian was never in Assam and knew next to nothing about elephants. The difficulty evidently lies in the classification of animals into wild and tame. According to Justinian every living creature which is not born in captivity is *feræ naturæ* (omnia animalia quæ in terra, mari, cælo nascantur). Blackstone, on the other hand, translates the phrase as "animals of a wild and untamable nature." Gaius speaks of "all animals which are captured on the land, or in the sea or sky:" but his definition was deliberately altered by Justinian. Elephants are undoubtedly born in a wild state (except in very rare instances) and are captured from it. But they are by no means of a wild and untamable nature. The elephant seems to have a double nature; in his original condition he is the most formidable of wild animals, but when caught and trained he becomes the most docile of domesticated creatures. In one of his poems Kipling speaks of him as:

> "Our lord the elephant, chief of the ways of God;"

and also as

> "Our slave the elephant, the servant of the Queen."

Although the doctrines of the jurists may be somewhat against my view, I think I must hold that an elephant which has been thoroughly tamed and domesticated for a long number of years, like the one in suit, becomes a tame animal, and that the owner's property in it continues, although it may be lost and recaptured, provided that its identity can be clearly established. If the opposite view were to prevail, the practical consequences would be disastrous. Elephants are constantly getting lost and are recaptured by their owners after a time. If an elephant becomes a wild animal as soon as it goes out of sight, as Justinian says, or as soon as the owner ceases instant pursuit, as Blackstone puts it, then he has no right to recapture it, for the Elephants Preservation Act, VI of 1879, makes it a serious offence to capture a wild elephant without a license. When elephant-catching operations are going on, it would

be an easy matter for the mahaldar's men to drive into their stockades tame animals which had been let loose in the jungle to graze. What is now one of the most valuable kinds of property in Assam would become one of the most uncertain. Moreover, much the same considerations would apply to the case of buffaloes in Assam, which are another valuable species of property. It would be highly inequitable to destroy the security of property in such valuable animals without cogent reasons and strong authority. I therefore find in plaintiff's favour the issue as to whether his ownership of the elephant in suit existed when it was recaptured in January 1904. It is obvious that the defendants are entitled to compensation for their trouble in catching the elephant as provided in Section 187, Contract Act. —*Pioneer.*

TIMBER HOUSES, BURMA.—All timber-built houses in Burma are built on posts, the first floors being raised some feet from the ground. Until quite recently the posts were sunk several feet in the ground. Owing to white-ants and rot this necessitated their being spliced every few years. Quite recently iron shoes have been used to fix the posts in, and the necessity for renewing the posts is thus done away with, as when exposed to the light and air they will last an indefinite time.

Photo.-Mechl. Dept., Thomason College, Roorkee.

No. 5.—Pure Shisham (Dalbergia Sissu) forest ready for felling for coppicing 15-years old.

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THE USE OF VERNACULAR TERMS.

Perhaps one of the most curious outcomes of the British World Empire has been the remarkable facility and the still more wonderful readiness the Englishman has shown for corrupting his own language by the introduction into it of words and terms taken from the local languages of the races among whom he resides either as a co-citizen or as the ruler over a conquered race. The introductions thus made are sufficiently puzzling to those who have no acquaintance with the languages from which they are adapted. Even more so, however, are the slang expressions coined by and understood only amongst those of his countrymen who have had the benefit, if benefit it can be termed, of residing in the particular portion of the world in which they are current.

Perhaps in no corner of the British Empire have such colloquialisms become so rampant as in India and this latter idiosyncracy is as much to be deplored, by those who have a love for the purity of the English language and an interest in the maintenance of that purity both in speech and literature, as is the use of pure vernacular words and terms. Unfortunately these habits of loose expression are not confined to speech alone, for slovenly methods in writing

are almost as rife as they are in speech, as a perusal of many of the Indian daily papers and of most of the so-called Anglo-Indian novels will prove beyond power of cavil. This aspect of the matter alone would seem to call for some remonstrance.

We are here concerned, however, with another phase, and a serious one, of the case. It has become a common custom to introduce into official correspondence, documents, and reports all sorts of vernacular terms and words which, although current in a particular Presidency, Province or even part of a Province and definitely understood there, are absolutely unintelligible to the dweller outside those limits. And if this is the case in India itself what hope can there be of the non-Anglo-Indian being even able to understand, much less obtain, the information he desires from such papers. May not this deplorable habit be one of the reasons why so little interest is taken at Home in Indian affairs furnish some justification for the fact that she has been so frequently entirely misunderstood in the past. As showing the alarming extent to which this laxity of expression, to call it by no worse a name, has become widespread, the following Army Order issued by Sir Charles Napier is to the point:—"The Governor unfortunately does not understand Hindustani, nor Persian, nor Mahratta, nor any other Eastern dialect. He therefore will feel particularly obliged to the Collectors, Sub-Collectors, and officers writing the proceedings of the Courts-Martial and all Staff Officers to indite their various papers in English, larded with as small a portion of the, to him, unknown tongues as they conveniently can. Any indent made for English dictionaries shall be duly attended to if such be in the stores at Karachi; if not gentlemen who have forgotten their mother-tongue are requested to produce the requisite assistance from England."

The above shows that the matter is productive of irritation and difficulties in working even in the Army.

In many of the Civil Departments in India the usage of local terms, though in the interest of the purity of the language a procedure to be strongly discountenanced and certainly never to be defended, may not be provocative of actual harm or delay, but

it cannot be contended that this is the case in the Forest Department or in any of the Scientific Departments in the country. Much of the work of the Forest Service is of a scientific and technical nature, and a man working in the north of India may, should, and does wish to consult reports, etc., written in Madras, Burma, Bombay, and Central India. Further the members of other Forest Services outside India wish to understand our methods of working and men engaged on all kinds of scientific work read Indian Forest Reports and papers. If we take up copies of any of the local civil administration reports what do we find? Local terms and expressions which have absolutely no significance outside the locality to which they refer and which are quite untranslatable and meaningless to the uninitiated are freely made use of without the hint of a foot-note to aid the seeker after knowledge. We all know how annoying quotations can be when interspersed in an unknown tongue in a book we are interested in. To quote some instances from Administration Reports recently issued: —*Kumaried*, *ponam* cultivation, *taungya* cultivation, *tope*, *thekadar*, *teri*, *dhimars*, *hugri*, *pattas*, *potta*, *Jhuming*, *kumri*, *takkal*, *driage*, *final June*, *kwins*, *partal*, *partalled*, *kazins*, *mali*, *pwés*, *sarwans*, *gowkhanas*.

But even a worse form of laxity than the use of local terms is the use of vernacular words for the scientific nomenclature of trees and plants, animals, etc., with the names of which a Forest Administration Report is naturally replete. The *Indian Forester*, it is readily admitted, has been an offender in this respect and is no exception to the rule although attempts have been made to grapple with this matter. Many hours have to be wasted endeavouring to ascertain the real name of a tree or plant alluded to under some vernacular term only. Articles have been continually sent to the *Indian Forester* which, had they been printed as sent, would have been unintelligible to 80 per cent of their departmental readers. And if this is the case with readers in India how much more so must it be for the Home reader or he in America, the Cape Australia, in fact in every country where a Forest Department exists to which the Magazine is sent. We do not mean to say

that the Indian Forest Department are alone in this laxity. Reports and papers received from many parts of the world teem with instances of the same want of thought for the reader, if not of respect for the mother-tongue.

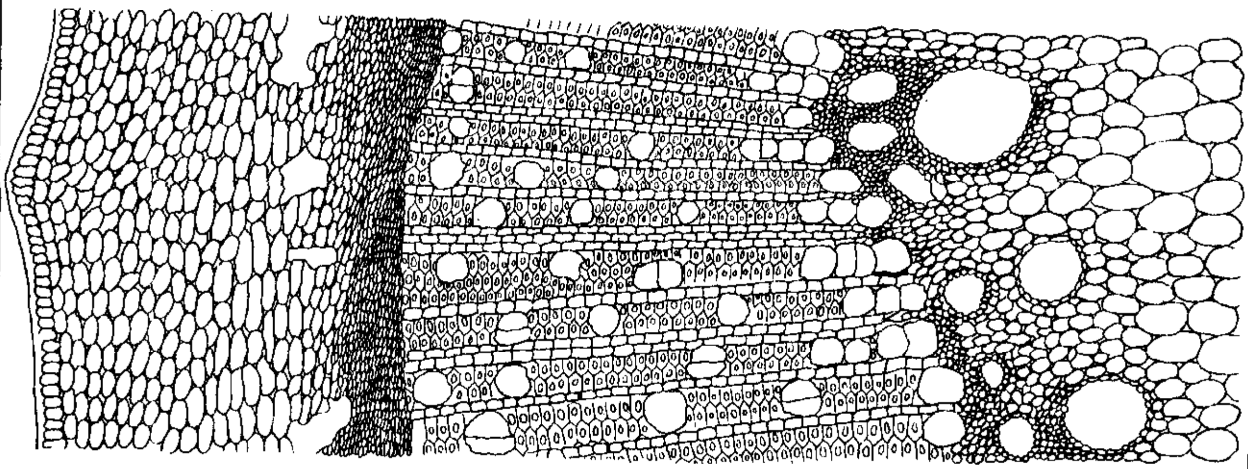
The following instances of the unexplained use of vernacular words in referring to trees, shrubs, animals, etc., are taken at haphazard from Indian Forest Reports :—

Sundra, bijasal, saj, matti, sain, asan, murada, ain, maru, nilgae, babul, pyinma, thitka, kamjin, taung-thanat, kyathungwa, yermaddi, anjan, harra, heerda, hilda, rola, hir, seegekai, yettega, bogi, devagargi, kaing, chil, chir, kail, kana, karil, tani, ahera, santi, thitsein.

It is not only the difficulty of understanding the terms and words used that has to be considered. There is the danger of actual mistakes creeping in as well. For instance, it is not an uncommon occurrence to find the same vernacular word applied to two different trees in two closely adjacent districts ; *e.g.*, Pinus longifolia is termed *chir* in Jaunsar which is in the United Provinces, whilst in the neighbouring district of Simla, which is in the Punjab not 50 miles away, the word *chir* is used to mean *Pinus excelsa*, the blue pine. Again *Pinus excelsa* bears the vernacular name of *kail* in Jaunsar in the N.-W. Himalayas, whilst further east in Garhwal and Kumaun the name *kail* is applied to the spruce, *Picea morinda*.

Now that the Forest Department has seriously commenced to plough the furrow of scientific research, is it too much to hope that the laxity of expression and the want of forethought that has crept into official and technical reports and papers may in future be eschewed, and that the writers thereof, remembering that India is a country of many races and many diversified languages, will confine themselves to the undefiled use of simple English, or, where scientific names are in question, make use of scientific nomenclature only ? When required the vernacular appellation may always be inserted in brackets.

Such a departure will be an invaluable boon to all workers and to all interested in maintaining untarnished the purity of the English language.



Mastixia euonymoides, Prain
Transverse Section of a Branch.
$\frac{90}{1}$

Photo.-Mechl. and Litho. Dept., Thomason College. Roorkee. Zinco., February, 1907.—No. 2593.—1000.

SCIENTIFIC PAPERS.

MASTIXIA EUONYMOIDES, PRAIN.

BY SIR DIETRICH BRANDIS, K.C.I.E., F.R.S.

In January last I received from Mr. Haines specimens of this tree collected in British Bhutan. With Dr. Stapf's kind help I recognised it as a *Mastixia*, and this was confirmed by the presence in the pith of large resin canals, surrounded as usual by an epithel of thin walled cells, which secrete the resin. The species had hitherto only been known from the Kachin hills in Burma and doubtfully from Manipur.

Resin ducts in stems and branches of *Dipterocarps* and *Conifers* are well known, but they are found also in other orders, of which the present is an instance. On thin transverse sections they can readily be recognised with a good pocket lens.

Kew, November 1906.

ORIGINAL ARTICLES.

THE LEVEL OF SUBSOIL WATERS WITH REGARD TO FOREST.

BY RALPH S. PEARSON, I. F.S.

The varying factors which govern the level of subsoil waters make it difficult to arrive at any definite conclusions with regard to the levels in and outside forest, and it is only after carrying out extensive observations spread over a large area that any definite results have been attained.

The opinion was formerly held by many foresters that the subsoil waters under an area covered by forest growth were equal to, if not higher than, the corresponding levels in lands not under forest.

To solve this point M. Ototzky, in 1895, commenced experiments in the forest of Chipoff (Government of Voronej) area in the Black Forest (Government of Kherson), Russia. Similar observations were made by M. Tolsky of the Staraïa-Russian Forest School in 1901-02 in the forest of Parfino (Government of Novgorod)

and under different conditions to those made by M. Ototzky. In France, M. Henry of the Nancy Forest School, has carried out, during the years 1900—02, detailed observations in the Mondon forest, near Leonéville (Meurthe-et-Moselle).

Lastly, during 1904-05, I took a series of readings both in and outside forest in the Godhra Range of the Panch Mahals district, Bombay Presidency. I must here thank M. Henry, with whom I have been in correspondence on this subject, for having given me his conclusions and data, which have put me in a position to compare my limited observations with those more detailed experiments carried out in France and Russia.

I propose to describe the results arrived at in Russia and France; then to give an outline of the Panch Mahals readings; and finally to compare, as far as possible, the results arrived at in these different countries.

Before going further it will be necessary to consider certain general points relative to the conditions which govern the level of subsoil waters, and under which reliable data only can be obtained. In all cases the areas chosen for carrying out the experiments had to be in the plains, on fairly level ground, the strata had to be approximately horizontal, and the soil and rock of such consistency as to allow borings to be carried out where necessary. The rainfall has next to be considered. Outside forest the rain reaching the ground is—

(*a*) partly absorbed and held in retention in the surface soil;

(*b*) partly absorbed by plants;

(*c*) partly evaporates on the surface;

(*d*) partly flows off the soil into rivers and streams;

(*e*) partly sinks to saturation point and forms subsoil water;

(*f*) partly sinks still lower to fill the subterranean reservoirs.

Inside forest the rainfall is accounted for in a similar way to that of outside forest, only that owing to the leaf canopy a certain portion never reaches the ground, but is held up by the branches and leaves and again evaporates in the atmosphere The amount

retained by the leaves varies according to the species and density of the forest. In well stocked woods it fluctuates between 15 per cent and 25 per cent of the total rainfall.

Another point to be considered with regard to the rainfall is that forests have a strong tendency to increase the local rainfall in and about the wooded area, but as all the observations taken outside were sufficiently close to a forest to feel this beneficial effect, this quantity may be disregarded.

Lastly, before examining the readings taken in the various countries, it is necessary to mention that the readings taken in the Panch Mahals have been converted from the English into the metric system, so as to facilitate comparison with the readings taken in France and Russia.

I.—Readings taken by M. Tolsky in the Parfino Forest (Government of Novgorod) 1901-02.

In the autumn of 1901, M. Tolsky made eight borings in the forest of Parfino (conifer) which is situated some 10 kilometres from the town of Staraïa-Russia, with a view of taking levels of the subsoil waters.

Four of these borings were made in two unexploited coupes and four in two adjoining exploited coupes. The strata under these coupes is composed of yellow sand and under this at some distance clay is found. Starting from the most elevated boring, No. 1, the greatest depression was 49 centimetres to No. 3, the lowest orifice, so that the site chosen for the experiment was very fairly level.

The mean distance between the first four holes was 70 metres, while that of the last four was less. The reason for boring the latter four holes so close together was to get the levels between the orifices of each hole as near as possible equal and also to obtain similar conditions of under-lying strata. Readings were taken twice a week over a period of 12 months; in April and May, however, owing to inundation some readings were interrupted.

The diagram showing the fluctuations of level between hole No. 1, outside forest, and hole No. 2, inside forest, is attached.

From such curves it is possible to at once get an idea of the influence of forest on subsoil waters, and also to deduce facts more easily than from tabulated figures. The first point that strikes one is that in no case does the level of the water in forest reach the level of the water outside forest at the same period of the year. The next point of interest is that, outside the influence of the trees the summer and winter readings vary. In summer they are higher but more irregular than in winter. Then again looking to the winter readings of both the curves it will be noticed that they have a tendency to be more regular in winter than in summer, a fact that is accounted for by the frost holding the surface waters ice bound and thus decreasing the supply below ground.

Then from the 29th December to the 13th January mild weather was experienced which caused the water levels to rise. Again from the 13th to the 22nd January frost came and the level sank, while from the 23rd to the 29th a thaw set in and the level again rose.

Taking the summer curves we find that the levels are directly influenced by the rain, thus from the 9th to 13th, from the 15th to the 21st and from the 23rd to 30th June, from the 7th to 14th, from the 17th to 22nd of July and from the 18th August to the 16th September fine weather was experienced and the level fell more severely outside than in forest.

Another point of importance is that the influence of rain seems on the whole to be felt more rapidly outside forest than in it. This one would expect as saturation through the humus and root system of the trees would be less rapid and not so excessive as outside forest.

It was also found that in borings Nos. 7 and 8, which were on the edges of the forest but just inside the influence of the trees, the readings were lower than actually outside, while in boring No. 6, the furthest in forest, the levels were lower than in Nos. 7 and 8 on the inside edge of the forest.

From this it may be concluded that the slightest presence of trees affects the level, while further in the forest the levels are lower than on the edge.

Lastly, it should be remarked that while the average difference between the levels was 50.2 centimetres lower inside forest for the borings Nos. 1 and 2, during winter, it was only 42,0 centimetres lower inside forest during the summer. (The above figures include the difference of 45 centimetres between the level of orifice Nos. 1 and 2, No. 2 being the lowest.) Having reviewed M. Tolsky's observations it will now be necessary to examine the conclusions arrived at by Ototzky after carrying out readings in other parts of Russia and under different climatic influences. In 1895 M. Ototzky, Conservator of the Mineral Museum of the University of St. Petersburg, was given the direction of the inquiry which was to be made regarding the lowering of the levels of the large rivers and the greater frequency of terrible famines in the south of Russia. In connection with this inquiry the Forest Department carried out experiments with regard to the levels of subsoil waters in and outside forest, and also on the climatic effect of forest on the rainfall. It was thought that forest played a very important rôle in connection with the rainfall where the annual fall was not over 60 centimetres and therefore the importance of the researches in this direction.

From borings taken in the forest of Chipoff (Government of Voronej) and in the Forest Noire (Government of Kherson) the following points were found :—

(*i*) That the waters were lower in the old woods than in young woods.

(*ii*) That from June to September, *i.e.*, during the period of greatest growth of activity, the subsoil level was 12 metres deeper in the forest of Chipoff than outside and 4 to 5 metres deeper in the Forest Noire.

There can be no doubt that these differences of level are not often met with, and the only way they can be accounted for is that owing to the very small annual rainfall (30 centimetres) the subsoil supplies are extremely meagre, and that during the period of maximum absorbtion by the trees the supply is drained to its utmost. To complete the investigation in this direction M. Ototzky in 1897 carried out further experiments but under different

conditions. He went further north to latitude 60°, in the forest of Oudielnaïa and Pavlosk (Government of St. Petersburg), where greater cold and a heavier rainfall were to be found, and where the forests were of conifers and not broad leaf as in Voronej.

Here he found that the water level in forest was from 50 centimetres to 1 metre 15 centimetres below the level outside forest, and this with a far heavier rainfall than in Voronej.

Thus it is clear that M. Tolsky's and M. Ototzky's results agree in the main point, *i.e.*, that subsoil waters in forest are lower than outside. The most interesting point to be deducted from the latter gentleman's experiments is that the levels in the smaller rainfall areas give greater differences of level than is the case in areas with a heavier rainfall.

II.—Readings taken by M. Henry in the Forest of Mondon, near Leonéville (Meurth-et-Moselle) 1900-02.

We now come to the experiments carried out by M. Henry in France. They cover a period of 28 months and began in May 1900. The site chosen for boring was in the Mondon Forest, which covers an area of 2,000 hectares. The subsoil is formed of ancient alluvial deposits, containing within two metres of the surface an argillaceous yellow sand, under which are found gravel beds for about five metres and lastly at a considerable depth come blue clays mixed with sometimes coarse and sometimes fine sands.

Boring was made down to a depth of 25 metres, after which the rocks of keuper formation of about 300 metres thickness are found. The strata is level, an important factor in such experiments.

The rainfall for 1900 was 713 millemetres and 891 millemetres for 1901.

Ten holes were bored of $0^{m},05$ diameter and fitted with zinc tubes perforated with small holes, thus avoiding the danger of the holes filling up. Five holes were made outside forest but not at a greater distance than 100 metres from the edge, while the other five holes were sunk inside forest and varied between 100 and 900 metres from the corresponding holes outside forest with which they were to be compared.

The greatest difference of level between any two pairs of holes was 1^m, 46, while the minimum difference was 0^m, 47. A diagram is attached which gives two pairs of curves, and I have therefore thought it unnecessary to give the readings taken each month. It is, however, necessary to state that, taking into consideration the difference of levels of the holes, in set No. 1 the average water level was 0^m, 30 deeper in forest than outside, in set No. 2 0^m, 20, in set No. 3 0^m, 42 and in set No. 4, 0^m, 31. In the fifth set readings were stopped owing to the orifices of the holes being flooded at certain times of the year.

Not taking into consideration the variations of level of the holes we get the following results :—

		Lower in forest by
Between holes 1 and 2	...	.. 1^m, 10.
" " 3 " 4	...	... 0^m, 63.
" " 5 " 6	...	... 1^m, 62.
		Higher outside forest by
" " 7 " 18	...	... 1^m, 15.

The only set which gives reverse readings is the fourth ; it has already been shown, however, that after reducing the holes to a mean level, the water level is lower in forest than outside in this set of readings, thus giving the same result as the other readings. If we now turn to the study of the curves, we at once see the same thing demonstrated here as in Russia, *i.e.*, that throughout the two years not once does the level in forest reach the level outside forest at any given period of time.

Again, in both the summer and winter curves one sees less fluctuation in forest than outside. Another point also worthy of notice is that on the whole the levels are higher in 1901-02 than in 1900-01, and this is owing to the greater rainfall in the period 1901-02.

Taking now for a moment into consideration all the readings we have up to now reviewed, we see that in the steppes of Russia, with a rainfall of only 30 centimetres, there is an enormous difference of level amounting to a deficit of 12 metres in forest ; going to St. Petersburg, with a rainfall of from 45 to 50 centimetres,

we get a difference of from 0^m, 50 to 1^m, 15, and lastly, going to Mondon in France with a rainfall of 80 centimetres, we get a deficit of 0^m, 30 to 0^m, 40 only. It is therefore safe to say that in Europe the axiom holds good that the difference of subsoil waters in and out of forest vary according to the rainfall, being greater with a low rainfall and *vice versâ*, but that in all cases the subsoil level is lower inside than outside forest. That this is true for India remains to be proved.

III.—Readings taken in the Mohulia Forest of the Godhra Range, Panch Mahals, India.

We now come to the readings taken in India. They were commenced in April 1904 and were carried on until April 1906, readings being taken every month for a period of 25 months. Owing to the want of money and appliances, the more correct method of boring holes could not be resorted to, and existing wells had to be substituted. Two sets of wells were chosen in different forests; one set had, however, to be abandoned as one well got inundated for a considerable time, and even after the flood had gone down the well contained flood water and so gave incorrect readings. On this account it is necessary to take the points deduced from one set of readings with extreme caution. I, however, publish them with the hope that they may induce other officers to carry out further observations on this point.

The two wells from which the readings were taken are situated in a flat country, one well being some 100 metres from the outside edge of the forest, while the second is situated some 1,200 metres inside a well stocked though irregular mixed teak forest. Both wells are lined with masonry through which the water finds its way in several places. Both wells are used by a very small community; but so as to avoid any deficiency of water caused by the people drawing water, the readings were taken early in the morning before the small quantity of water was taken out, thus giving the wells ample time during the night to compensate themselves for this loss.

Levels were taken between the orifices of the two wells, which showed that the Aichala well in forest was 2 metres (6 ft. 5 in.) below that of the Mohulia well outside forest. This difference of level has been taken into account in drawing the curves shown below. The underlying strata consists for the first 40 centimetres of black soil, the result of the decomposition of the surrounding trap rock. Directly below this the strata gradually turns to a fine sand, then becoming mixed with gravel and large pebbles, the layers of which are in places highly impregnated with lime, forming what is locally known as kankar. The whole of these deposits vary in thickness from 5 to 10 metres. Below these come the trap; in this locality they are in the form of striated rock, weathering brown, and easily decomposed by atmospheric agencies. They are pervious to water to a very fair degree, thus allowing percolation of the subsoil waters. As you go deeper the rock becomes less striated, especially about the Aichala well, and it is, with the exception of fissures, impervious to water. The strata is inclined to the east, having a dip of from 3 to 5 degrees. A word must be said regarding this dip in the strata, as it would destroy any reliable record of the levels were not the two wells situated at right angles to the direction of the dip.

We now come to the readings themselves, of which the figures are given on the next page and a diagram showing the levels by a curve is attached.

The first point to be noticed is that the level inside forest never surpasses the level outside forest at any given time, thus agreeing with the results of the Russian and French experiments. Looking to both curves for the year 1904, we see that in April and May, before the rains had had time to affect them, they stood relatively much higher than in the same months of 1905. Also it should be noticed that in 1904 they both fell in May and were only prevented from falling lower by timely rainfall; further that in spite of the rains they only rose very slightly, if at all. The reason for this was that the normal rainfall of 1903 (99", 31.) kept the level high even up till April 1904, but the rainfall of 1904, being only 45", 80, was quite insufficient and did not even bring the levels up to summer normal.

Depth of water in my Aichala and Mohulia wells from the 8th April 1904 until 10th April 1906.

Year.	Date.		AICHALA. Well inside forest	MOHULIA. Outside forest.	Rainfall for the month.	REMARKS.
			Metres.	Metres.	Centimetres.	*Note.* Total for 1903 = 99^{c},31.
1904	8 April	...	10 17	5 57	...	
	11 May	..	10 95	5 66	0 15	
	12 June	...	10 50	6 01	12 59	
	12 July	...	10 68	6 12	19 74	
	11 Aug.	...	10 62	6 12	3 57	
	11 Sept.	...	10 62	6 21	9 35	
	9 Oct.	...	10 50	6 25	...	
	12 Nov.	...	10 62	6 58	...	
	11 Dec.	...	11 23	6 67	0 36	Total rainfall 45^{c}, 80.
1905	12 Jan.	...	11 69	7 13	...	
	12 Feb.	...	11 97	7 58	0 25	
	12 March	...	12 24	8 50	...	
	12 April	...	12 43	9 41	...	
	11 May	...	12 52	9 32	...	
	13 June	...	12 80	9 87	1 65	
	12 July		12 70	7 67	93 49	
	12 Aug.	...	12 43	5 21	3 71	
	11 Sept.	...	11 97	4 93	11 43	
	11 Oct	...	12 06	5 02	...	
	12 Nov.	...	11 89	5 48	...	
	14 Dec.	...	11 24	5 75	...	Total rainfall 110^{c}, 83.
1906	11 Jan.	...	11 20	6 01	...	
	11 Feb.	...	11 33	6 49	...	Difference 4^{m} 74, taking into account difference of level of the two wells.
	12 March	...	11 69	6 85	...	
	10 April	...	12 36	7 31	...	
	Mean	...	11 45	6 71		

This short rainfall of 1904 had a further effect of making the levels fall very low in the hot weather of 1905, nor was the effect of the low rainfall of 1904 fully compensated for by the large fall of 110^{c}, 83 in the rains of 1905; especially was this the case in forest. It has been found from long experience in India that it takes several years for the subsoil levels to recover fully after a very short fall in any year, and this is borne out by the curves representing the levels and this was also especially noticeable after the great drought of 1900.

At the beginning of June 1905 we see both curves at their lowest; after that owing to the abnormal falls in June of 93, 40 centimetres they both rise. The curve showing the levels outside forest rushes up in the two months of July and August while the levels inside forest rises but very gradually. On the other hand, the levels outside forest attain the highest point in September and after that fall sharply, while the levels inside go on rising until December and then only fall gradually. It is obvious from the above that the effects of rain outside forests are felt quicker and fall sooner than in forest and this is due to the influence of the trees which help to retain the moisture longer on and near the surface before it sinks down to feed the subsoil supplies.

Lastly, a word must be said regarding the average mean levels of the two sets of readings. From the table it will be seen that the average is 4, 74 metres lower in forest than outside, a figure which stands between the figures shown by M. Ototzky for the dry steppes of Russia, with a small rainfall, and the figure for the moister climate of St. Petersburg.

IV.—Conclusions.

In summing up the results obtained, we have :—

(*a*) In all cases the levels inside forest are lower than those outside the tree influence at one and the same time.

(*b*) That the level is steadier inside than outside forest.

(*c*) That the effect of rain is felt later inside than outside, and in India the effect of rain lasts longer in than out of forest.

(*d*) That it has been shown in Europe that the difference of level is greater further inside than on the inside edge of forests. This point remains to be proved for India.

(*e*) That old woods lower the level more than young woods; this also wants proving for India.

(*f*) In India the effect of a short rainfall in any given year takes more than one normal year of rainfall to compensate the former deficiency.

(*g*) That the amount of rainfall in any locality has a direct influence on the difference of level in and outside forests. Thus in a low rainfall area the difference of levels is greater than where the rainfall is more abundant.

There is nothing disquieting about the above results; on the contrary they show strongly the regulating and compensating effect of forest. The lowering of the level is fully compensated for by its greater regularity, and this is by no means the greatest benefit obtained. We have only to ask why are the water levels in forest lower than outside its influence? The reason is no doubt that the demand made by the tree on the subsoil water is far greater than that made by an agricultural crop, for though a field crop may make an equal demand to that of a forest crop within 50 centimetres of the surface, it does not tap the subsoil waters in the same way. Now this water which is absorbed by the trees is in a great measure again given off into the atmosphere through the leaves, thus increasing the moisture in the atmosphere which again falls to the ground as rain in the surrounding districts. As an example of this may be given the experiments carried out in the haute Sambre by M. Bouwart and given by M. Henry in his article on this subject. Five stations were chosen within the radius of influence of the forest and the mean of these five readings when reduced to the level of the sixth station outside forest influence gave a rainfall of 855 millemeters as compared with 737 millemetres at the latter or 118 millimetres in excess. Thus the rainfall was increased by 16 per cent within the forest radius. As another example I am told on good authority that the rainfall over the Changa Manga plantation

Plate 1

Curves representing the level of subsoil waters in an exploited coupe and in forest in the forest near Staraïa-Russa.

RUSSIA.

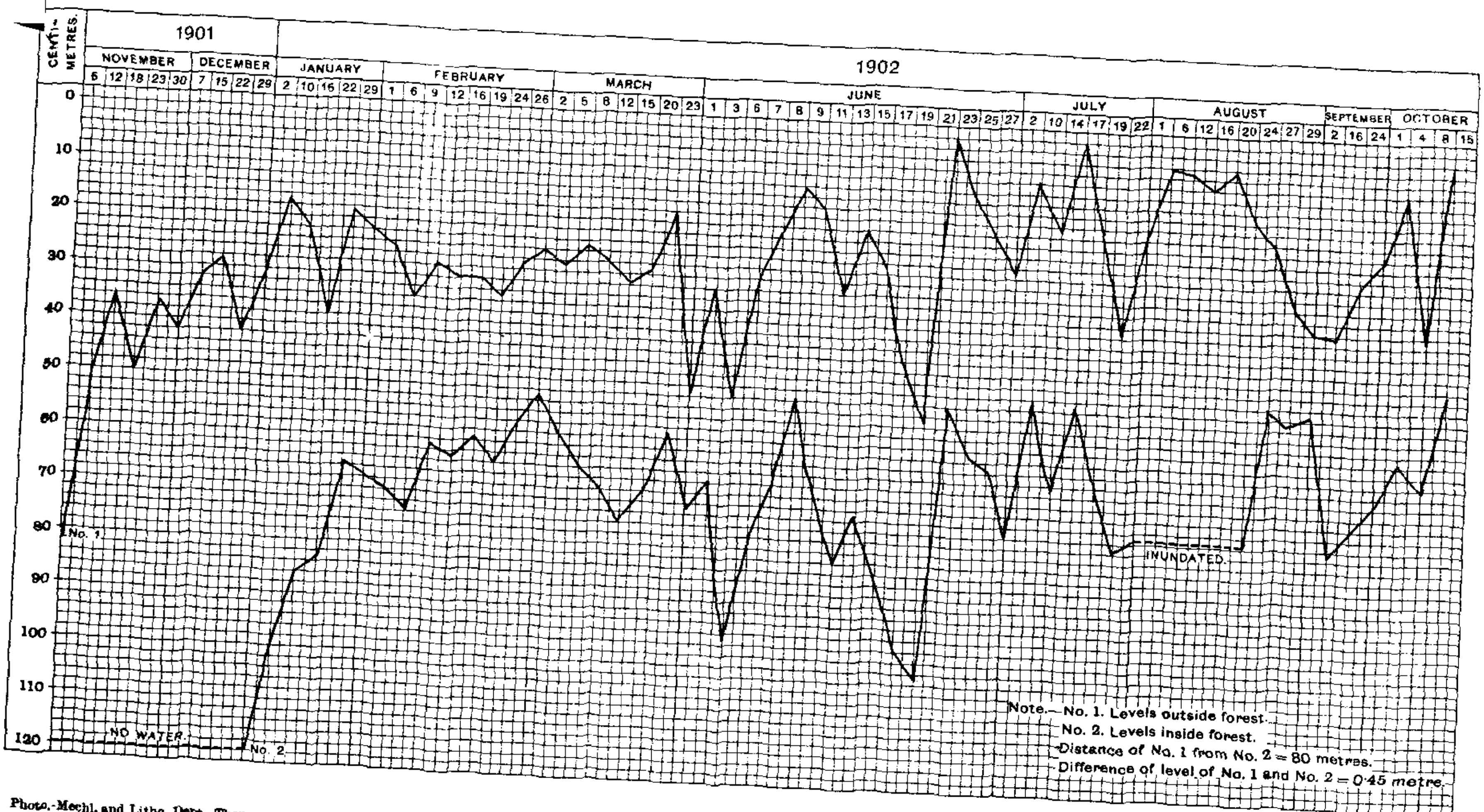
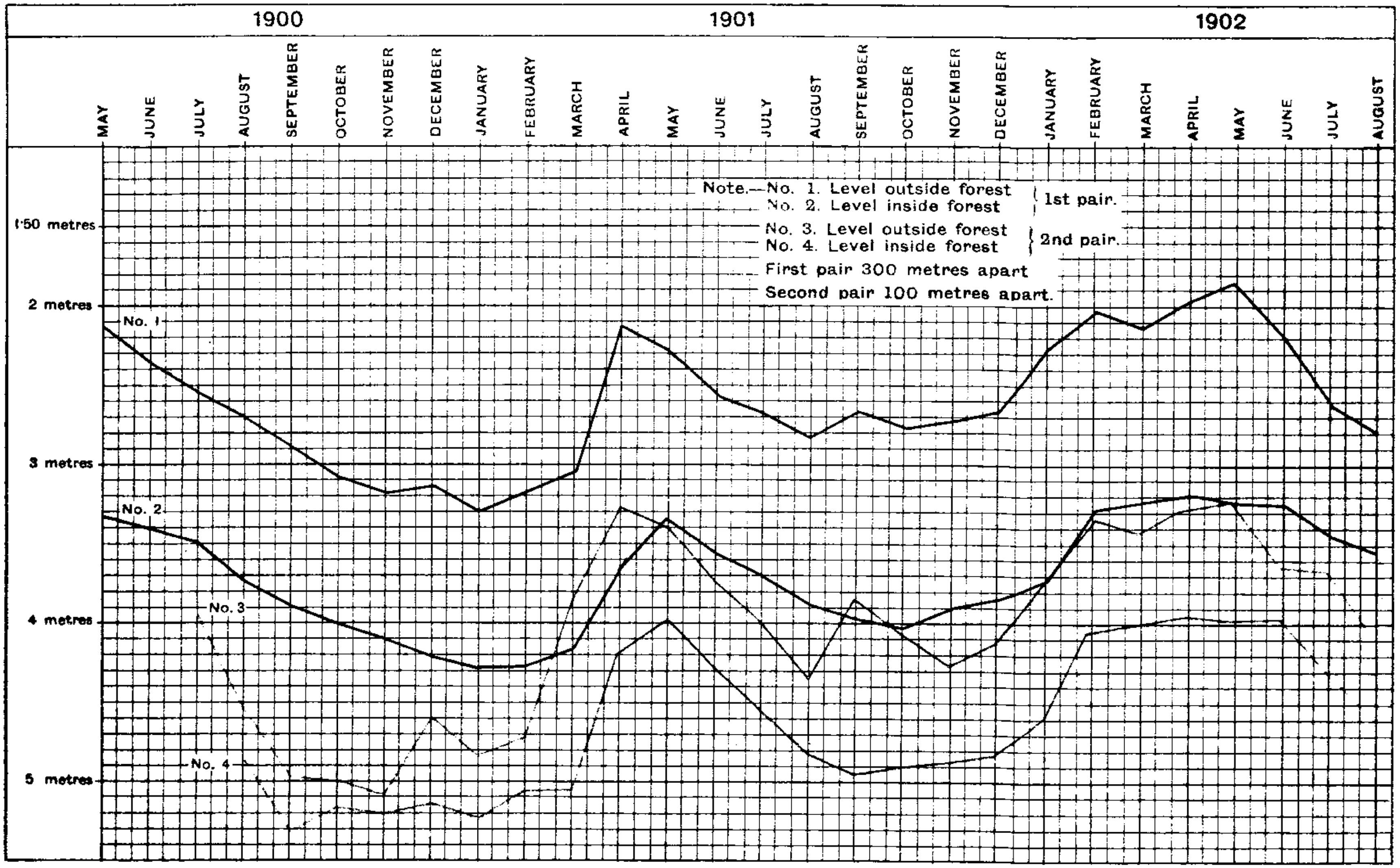


Photo.-Mechl. and Litho. Dept., Thomason College, Roorkee.

Zinco, February, 1907—No 2603.—1020.

Plate 2

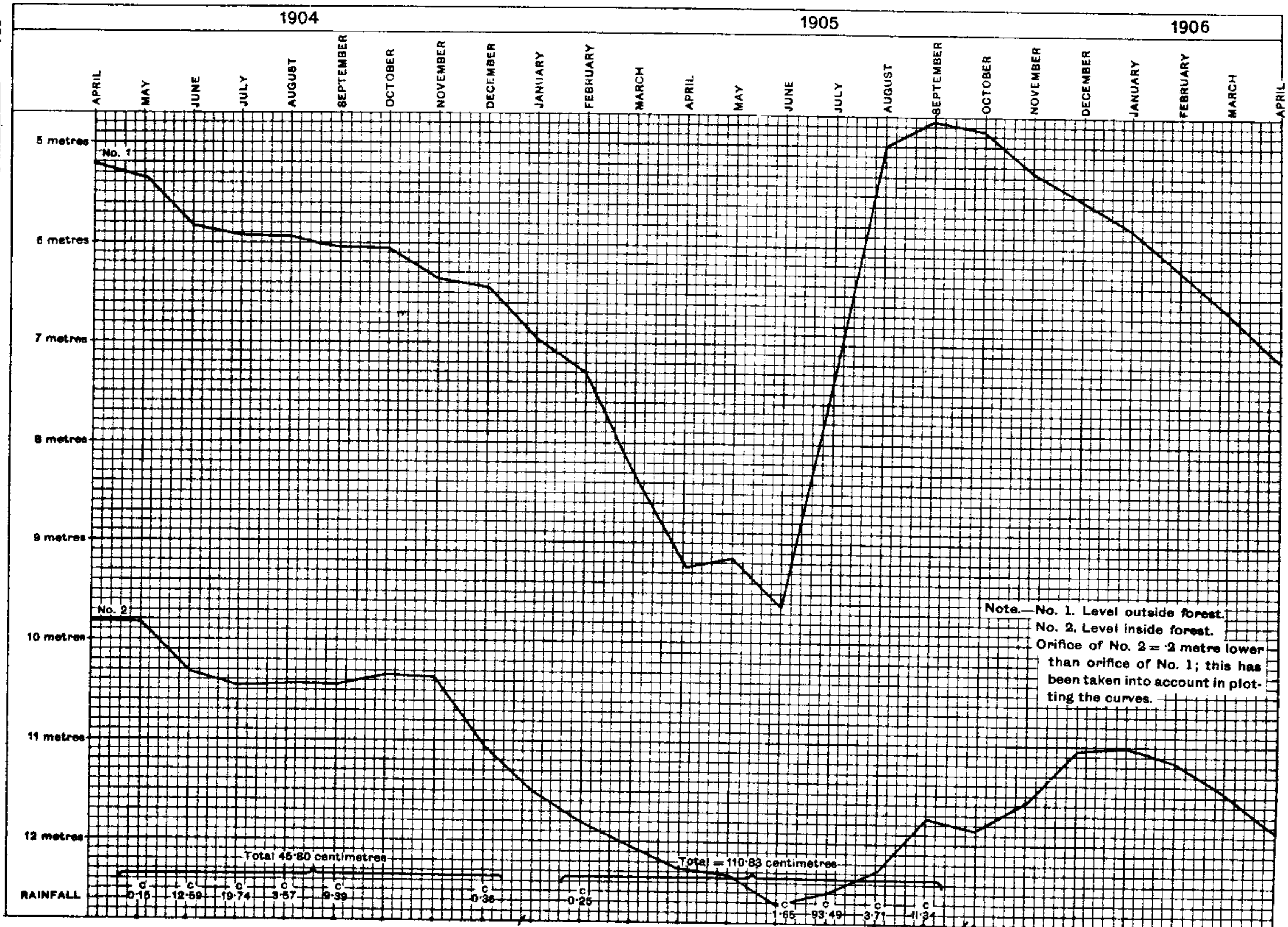
Curves representing the level of subsoil waters in four borings, two inside forest and two outside, in the Mondon Forest Meurthe-et-Moselle, France.



No. 2603-1—1020.

Plate 3

Curves representing the level of subsoil waters in two wells, one inside and the other outside forest, in the Godhra Range, Panch Mahals District, Bombay Presidency, India.



No. 3603-2.—1020.

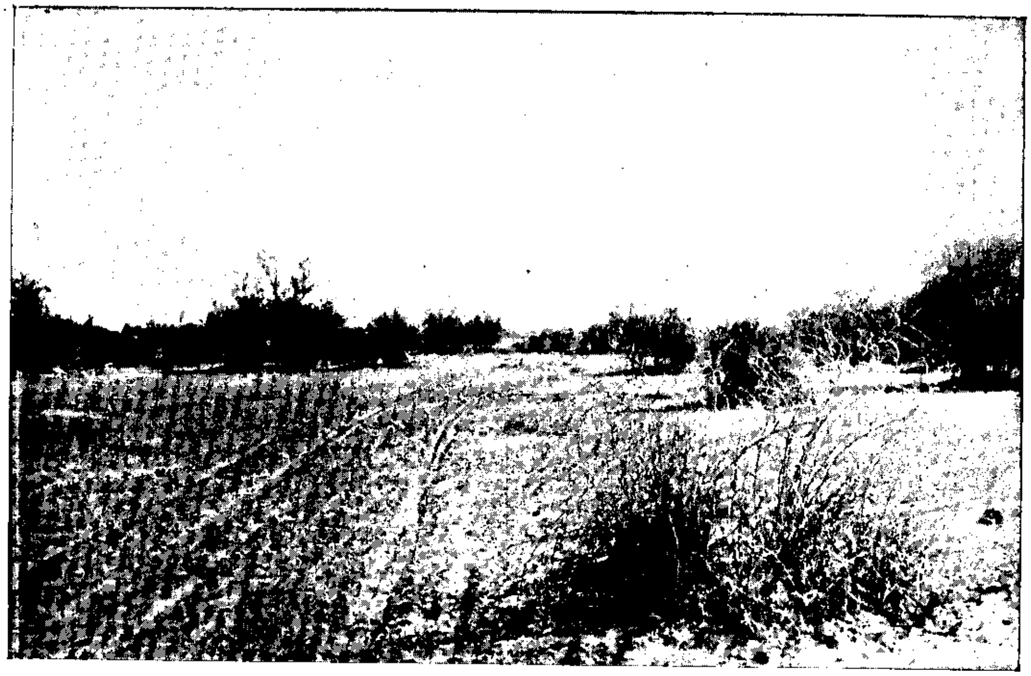


Fig. 1.—Punjab Rakh, taken just outside the Changa Manga plantation.
It was from rakh land of this nature that the plantation was formed.
Vegetation consists of Capparis aphylla (in foreground) Salvadora and Prosopis spicigera (Jand).

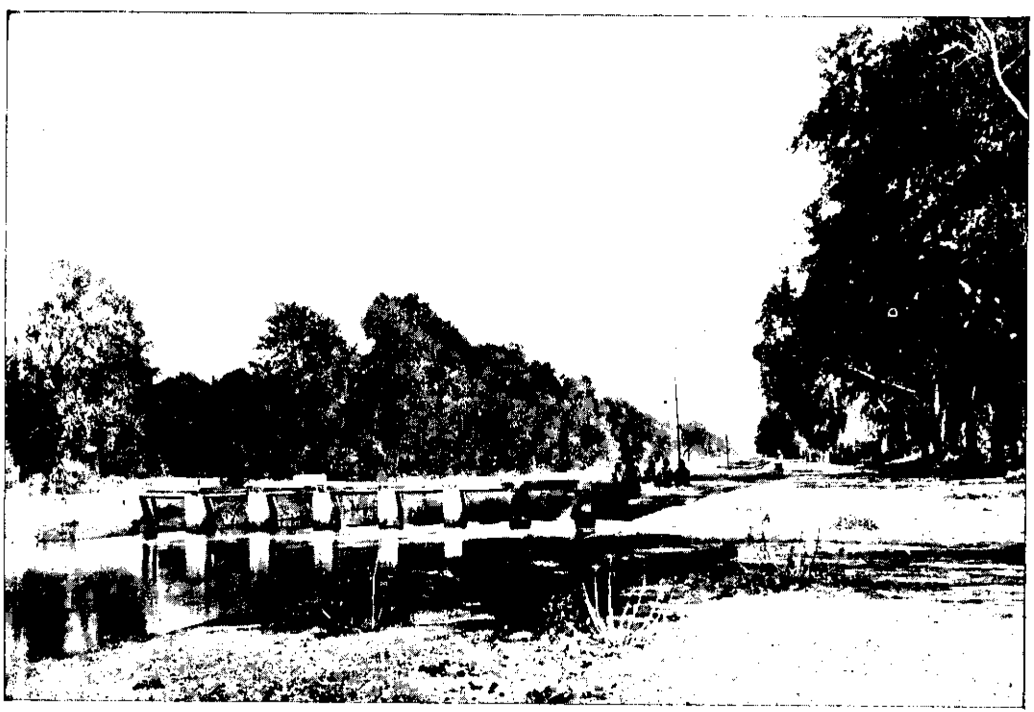


Fig. 2—Weir on the Bari-Doab Canal inside the Changa Manga plantation.

Photo. Mechl. Dept., Thomason College, Roorkee.

has considerably increased since its creation, but of the actual figures on this point I have none before me.

It will be obvious to all that my readings leave much to be desired and that further experiments are necessary, especially in areas of varying rainfall.

Before leaving this subject I would say a word regarding an article which appeared in the *Indian Forester*, page 335 of Vol. XXVII, by F. A. Leete. He states that he found the level of water in a river several feet below that in adjoining wells and asked for the reason. I should be inclined to think that the reason for this difference is that, firstly, the water not being held in retention in a river, as is the case in a well, flows away and thus lowers the level, and, secondly, that owing to the capillary attraction of the soil the subsoil waters will naturally stand higher in the ground, and again that the further one goes from the river bank the higher will be the level. It is also a foregone conclusion that were the waters in the ground not higher than in the river beds, the supply for the streams would be cut off.

KINGTON, HEREFORDSHIRE:
16th November 1906.

THE CHANGA MANGA PLANTATION.

BY B. O. COVENTRY, F.C.H.

There has been from time to time correspondence in the *Indian Forester* in connection with the Changa Manga plantation, and so perhaps your readers may like to see a short series of photographs illustrating subjects of interest and different phases in the formation of the plantation.

It is not I think necessary to describe the plantation at any length, beyond merely explaining, for the benefit of those unacquainted with it, that the plantation is a mixture of Dalbergia sissoo (Shisham or Sissoo in Vernacular) and Mulberry worked as coppice with standards and yielding about 2,000 c.ft. solid per acre in firewood at the final fellings, with a 15 year rotation. The

plantation is maintained by artificial irrigation from the Bari Doab Canal.

The following brief notes may help to explain the photographs :—

Plate 8, fig. 1, represents a typical Punjab rakh in the Lahore District, and shows the kind of land from which the Changa Manga plantation was formed. The photograph was taken in rakh Jalleki adjoining the plantation. The species of trees are Salvadora, Capparis aphylla and Prosopis spicigera.

Fig. 2 in the same plate shows a weir on the Bari Doab Canal. This canal passes through the plantation and irrigates it by means of a carefully laid out system of water-courses and channels.

Plate 9, fig. 1, depicts a newly formed portion of the plantation, part of the Gandhian extension, consisting of one year old shisham plants from sowings. It was previously, before being irrigated and sown up, land of a similar nature to that shown in fig. 1, Plate 8.

Plate 6. Mature forest ready for coppicing, the trees being 15 years old. The small irrigation channels which can be seen in Plate 9, fig. 1, are no longer visible, having become silted up.

Fig. 2 in Plate 9 represents the felling area, showing standards, stacks of firewood, and brushwood.

Plate 10 shows an area of young coppice one year old. The brushwood seen in fig. 2, Plate 9, has been burnt and the ground is covered with young coppice.

The fuel from the felling area is carried to the depôts by means of a tramway.

Fig. 1.—Shisham seedlings one-year old on land brought under plantation by irrigation and sowing.

Fig. 2.—Felling area, showing standards, stacks of fuel, and brushwood

Photo.-Mechl. Dept., Thomason College, Roorkee.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

PROHIBITED RIFLES.

A MODIFICATION.

By a Home Department Notification, dated the 11th September 1906, certain amendments were made in the Home Department Notification, dated the 6th March 1879, with which were published rules under the Indian Arms Act, (II) of 1878. The effect of these amendments was that, whereas formerly the importation of rifles of ·450 bore and Martini-Henry pattern only was prohibited, the importation of all rifles of ·450 bore, irrespective of action or of size of breech, became illegal after the 10th September 1906. Subsequently it was pointed out that these orders entailed a hardship upon persons who had actually exported such rifle from England, but had not landed them in India prior to the date of this notification, and it was accordingly decided to postpone the operation of the rule until the 27th October 1906. Since that date, however, a number of applications have been received for special permits to import such rifles, the applicants representing that they had ordered the weapons in England some time previous to the issue of the notification of the 11th September

1906, in ignorance of the intention to prohibit their import in future. The Government of India recognise that in such cases the orders may have caused hardship, and in a number of instances they have granted special permits for the importation of the weapons. Numerous representations have now been received from manufacturers and dealers in arms and ammunition, both in India and in England. It is pointed out that the orders prohibiting absolutely the importation of rifles of ·450 bore will cause a heavy loss to all firms connected with the trade in arms and ammunition in India, and to manufacturers of arms and ammunition in England who have laid down the machinery for turning out ·450 rifles and ammunition ; and that the orders will also impose a very serious restriction on Indian sportsmen who are now in possession of sporting weapons of this calibre, and who will be unable in future to obtain ammunition for them.

The Government of India consider it desirable in the first place to remove a misapprehension regarding the sale of ammunition to persons in India, who are already lawfully in possession of sporting ·450 bore rifles. Although it has been decided to prohibit direct importation by such persons of ammunition for these rifles, there is no intention of interfering with the provision in Rule 6 (II) of the rules under the Arms Act, under which a local Government may grant licenses to selected dealers to hold a limited amount of ammunition for rifles of prohibited bores upon certain conditions. This rule will shortly be amended so as to include ammunition for rifles of ·450 bore, other than those of Martini-Henry pattern. It will, therefore, still be possible in future for exempted persons possessing such rifles to obtain ammunition for them from selected dealers in India.

PROHIBITION ABSOLUTE IN MAY.

With reference to the other representations put forward by members of the gun trade, the Government of India recognise that their recent orders prohibiting absolutely the importation of rifles of ·450 bore may have caused hardship and loss to the trade, as well as to the individuals who ordered such rifles prior to the issue of the recent notification. While adhering, therefore, to their decision

to stop the importation of all rifles of ·450 bore, they have decided to accept in part the suggestion made by the London Chamber of Commerce, *viz.*, to permit the importation into India, for a reasonable period, of rifles in respect of which manufacturers can furnish absolute proof that they were actually in the course of manufacture on the 11th September 1906. In pursuance of this decision the Governor-General in Council is pleased to make the following rules regarding the importation of such rifles :—

"Gun dealers and manufacturers in India may apply to the local Government for special permits for the importation of all rifles of prohibited bore which were *bonâ fide* ordered, and were actually in the process of manufacture prior to the 11th September 1906, by persons of the exempted classes resident in India. Such applications must be supported by the necessary documentary evidence and must be submitted before the 1st of May next, after which no applications will be received. Local Governments will forward the applications to the Government of India, with whom will rest the decision as to whether the permits shall be granted or not.

"The Secretary of State for India will, at the same time, be asked by telegram to inform the gun-dealers and manufacturers in the United Kingdom that applications may be forwarded to him so as to reach him before the 1st of May next for permits to import into India rifles of the prohibited bore, which have been ordered direct from them, either by exempted persons resident in India or by exempted persons now in England who intend to import them into India when completed. Similar evidence will be required by the Secretary of State as to the *bonâ fides* of the order and as to the fact that the rifle was actually under construction on the 11th September 1906. The Secretary of State will be asked to forward all such applications received up to the 1st of May next to the Government of India, who, if satisfied as to the genuineness of the order, will issue special permits for their import. No application for the import of a rifle of ·450 bore will be received or attended to after the 1st of May 1907, on which date the prohibition will become absolute."

Calcutta, 16th February.

EXTRACTS FROM OFFICIAL PAPERS.

THE CULTIVATION OF CAMPHOR ON THE NILGIRI PLATEAU.

GOVERNMENT OF MADRAS.

REVENUE DEPARTMENT.

No. 953-Revenue, dated 26th September 1906.

Read—Proceedings of the Board of Revenue (R.S. L.R. and Agri.), Mis. No. 5454, dated 8th September 1906.

The Hon'ble Mr. A. E. Castlestuart Stuart, I.C.S.

Read—the following paper :—

Letter—from L. E. Buckley, Esq., I.C.S., Collector of the Nilgiris.

To—the Secretary to the Commissioners of Land Revenue.

Dated—the 29th August 1906.

No.—Ref. on Cur. 1527.

I have the honour to state that Mr. J. McKenzie of Prospect Estate, Nedivattam, has applied (application, dated 23rd July 1906, is enclosed) for remission of assessment on 60 acres of land which he proposes to plant with camphor in Prospect Estate. As camphor has not yet been recognised as a special product, I called for remarks from the Curator, Government Gardens, Ootacamund, as to the prospect of its successful cultivation in this district and the length of time for which the product will yield no return. From his letter, dated 4th instant, copy enclosed, it appears that the cultivation is worth encouraging, and that it will not yield any return till the trees are five years old.

2. Under these circumstances I recommend that camphor be recognised as a special product, and that the cultivation may be exempted from assessment for five years.

ENCLOSURES.

Application—from J. McKenzie, Esq., of Prospect Estate, Nedivattam, the Nilgiris.

To—the Collector of the Nilgiris.

Dated—the 23rd July 1906.

I have the honour to inform you that we propose planting up an area of about 60 acres of land on these estates with the new

product camphor, and therefore I have to request that a remission of the annual assessment upon this area may be granted from next year for the usual number of years.

> *Letter*—from R. L. Proudlock, Esq., Curator, Government Botanic Gardens and Parks, the Nilgiris.
> *To*—the Collector of the Nilgiris.
> *Dated*—the 4th August 1906.
> *No.*—797.

With reference to your R. C. No. 1527 of 1906, dated 2nd instant, I have the honour to state that the camphor is a tree which will grow successfully in good soils where the annual rainfall is not under 50 inches from sea level up to the highest elevations on the Nilgiris—*vide* paragraph 45 of this Garden report for 1900-1901. It is valued for its camphor and camphor-oil.

It will not yield sufficient leaves to cover the cost of extraction of the camphor from them till it is five years old, if the method of growing it as a clipped bush which I suggested in paragraph 7 of the Garden report for 1899-1900 be adopted. In view of the action of the Japanese Government in trying to create and to obtain a monopoly of the camphor industry in Formosa, it is highly advisable to give the fullest encouragement to planters in this district to plant camphor trees. There is every prospect of it being a remunerative product in this district if it were planted under proper conditions on a sufficiently large scale.

No. 953-Revenue, dated 26th September 1906.

Mr. McKenzie has several trees of camphor growing at Prospect and he is well enough acquainted with its cultivation. He has also extracted camphor from the leaves of his trees on a small scale several years ago. Moreover, Mr. McKenzie has been in correspondence with me and has seen me many times on the subject of camphor for many years now. His letter is returned herewith.

Resolution—Mis. No. 5454, dated 8th September 1906.

The letter from the Collector of the Nilgiris read above will be submitted for the orders of Government, with reference to paragraph 1 of G.O. No. 794-Revenue, dated 25th July 1904, and in

continuation of the correspondence ending with G. O., Mis. No. 2059-Revenue, dated 15th December 1904.

2. The Board supports the Collector's recommendation that camphor may be recognised as a "special product," and that the assessment on lands newly planted with that product in the Nilgiri plateau may be remitted for five complete years.

L. D. SWAMIKANNU,
Acting Secretary.

Order—No. 953-*Revenue, dated* 26*th September* 1906.

Miscellaneous.

The Government accept the Board's recommendation that the camphor tree (Cinnamomum camphora, *F. Nees*) may be recognised as a special product and that the assessment on lands newly planted with that product in the Nilgiri plateau may be remitted for five complete years.

A. G. CARDEW,
Ag. Secretary to Government.

MISCELLANEA.

XV.—THE CHIEF TIMBER TREES OF INDIA.

(Continued from page 48.)

BY J. NISBET, D. OEC.

II.

The Bombay BLACKWOOD, perhaps better known in England as "Indian rosewood" (*Dalbergia latifolia*), is a valuable and extremely hard and close-grained furniture wood of a dark purple colour with black longitudinal streaks, deepening with age, in which the annual rings are quite indistinct. It is found throughout the whole of the Indian peninsula, but not in Burma, and it attains its finest growth along with teak and bamboos in the dry forest of the Western Ghat's where it ascends to an elevation of about 3,500 feet. It is essentially a tropical tree, and attains its finest

growth in the southern localities. Though not an uncommon tree, it is nowhere abundant. In can be easily raised from seed, besides freely sowing itself naturally, and it has a strong reproductive power in throwing out coppice-shoots. It is a tree of slow growth, though it ultimately reaches a height of 80 feet, with a girth of from 12 to 15 feet, the largest recorded specimen being 20 feet. It takes about 100 years to attain a girth of 6 feet. The black carved tables, chairs, sideboards, etc., made of this fine wood are not as fashionable now as they used to be, so that there is in some places less demand for the wood than formerly. One result of this has been that it has been used for sleepers; but though well suited for this as to durability, it seems a pity that so fine a timber should be used for purposes for which less beautiful woods are equally well adapted. In these days of specialities in furniture, it should pay some large firm to develop the blackwood industry in Britain.

The BABUL (*Acacia arabica*), a tree of moderate size, with hard pinkish-white heartwood turning reddish-brown on exposure and mottled with dark streaks, is one of the most important trees in the arid regions of western and northern India. Its true home is among the sandy wastes of Sind, Rajputana, Guzerat, and the North Deccan, but it is also found self-sown and cultivated throughout all the drier regions of Central and Upper India, and much is done for its cultivation in Sind and the Punjab. Sometimes it grows gregariously in patches, sometimes merely scattered about in single trees or small knots. In these dry tracts, usually poor in timber, it is an exceedingly valuable tree, yielding not only fine timber, very durable when well seasoned, and much used for wheels, sugar and oil presses, rice pounders, agricultural implements, etc., and making excellent fuel, but also furnishing tanning and dyeing products from its bark and pods, while the branches and leaves are used as fodder, and the thorny boughs for fencing fields. The babul tracts of the arid regions are therefore carefully reserved and worked systematically. Though babul is a free seed-producer, reproduction is often difficult within the reserved areas, as insects destroy the seed. To obviate this difficulty goats are often grazed inside the reserves and allowed to feed on the pods, and when

the seeds pass through undigested they have a better chance of germinating. Otherwise it has good reproductive power and coppices well, while it may also be grown from cuttings. Though not usually a large tree, it reaches a height of 50 to 60 feet, with a girth of 6 to 8 feet, the largest known tree being one at Pandharpur in Bombay, 80 feet high and 14 feet in girth. In Sind it usually takes about 35 years to reach 4 feet in girth, and about 55 to attain the mature girth of 6 feet, while its rate of growth is generally quicker in the Punjab. In some parts of Madras the babul forests are worked as coppice-under-standards, with a rotation of 20 years, in order to furnish supplies of much-needed fuel and fencing-thorns.

(*To be continued.*)

NEW FOREST RESERVE IN BURMA.—We notice in the Burma Gazette (December 29th, 1906), the notification, under the provisions of section 18 of the Burma Forest Act, 1902 (Burma Act IV of 1902), of a new reserve in the Minhla Township of the Tharrawaddy District. The reserve which is approximately 689 miles in area will be known as the Satthwa Reserve.

Photo.-Mechl. Deps., Thomason College Roorkee.

No. 7—Young coppice one year old with standards.

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MARCH, 1907.

THE NEW REORGANISATION OF THE IMPERIAL FOREST SERVICE

The pages of the *Indian Forester* have often been the channel through which the Department has been reminded of the disadvantages under which it is labouring and also of performing the more pleasing task of acknowledging the removal of such causes for discontent. An illustration of the latter has recently made its appearance in the form of a Resolution, which we print in full elsewhere, and a portion of this article will be devoted to placing before our readers some of the disabilities from which the Service is still suffering.

A perusal of the Resolution will show that the old system of payment by grades has been abolished and a system of personal pay, dependent on the length of service of the individual officer, been substituted in its place. On arrival in India the Forest Officer will now draw Rs. 380 per mensem rising by yearly Rs. 40

increments to Rs. 700 per mensem in the 9th year of service and thence by Rs. 50 annual increments to Rs. 1,250 per mensem in the 20th and following years.

Two conditions limit the operation of the annual increments,—(1) the Assistant Conservator cannot draw more than Rs. 460 per mensem until he has passed the examinations prescribed in Article 74 of the Forest Department Code; and (2) Local Governments are authorised to stop the incremental rise of pay of any officer whose work in its opinion is not of a satisfactory nature.

Roughly speaking the difference between the old and new scales of pay may be taken at an average increase of under Rs. 200 per mensem during the period of service in the Assistant and Deputy Conservator class during the first 20 years of service, and we feel that we are voicing the sentiments of the Department as a whole when we express satisfaction at the removal of some of the serious disadvantages under which it was suffering in comparison with the Departments similarly recruited; disadvantages which were obviously resulting in apathy or discontent, neither of which could be conducive to good work.

This expression of satisfaction is however somewhat discounted when it is considered that the Forest Department is still in some respects in an inferior position. For instance, the rule forbidding the drawing of exchange compensation allowance, which is permitted in the Public Works Department under precisely similar conditions to those now existing in the Forest Department, detracts a little from the generosity which is so marked a feature of the present reorganisation, and our readers may notice other restrictions of a similar nature.

But whilst the prospects of the junior ranks of the Service are now improved perhaps beyond present expectation we trust the present Resolution will not be held to permanently complete the reorganisation of the Imperial Forest Service. Much has been done, but the responsible heads of the Department still draw salaries inferior to those of any other Department with which comparison may fairly be made, and this drawback will become

more accentuated as the Forest Department increases in importance as it is certain to do year by year.

If we were requested to point the direction in which improvement is still possible, we should say that until the emoluments of the Forest Service—which, perhaps unfortunately, is the criterion by which services are classified in India—equal those given in any other similarly recruited scientific Department, so long will there be a difficulty in recruiting for the Forest Service and of obtaining the best work from its members, more especially as it is known that the Indian forests will yield an ever-increasing revenue to the public purse which is not the case with the majority of scientific Departments.

We turn now to the question of pensions This is not touched upon in the present Resolution but it merits nevertheless serious consideration.

As is well known the Forest Department has a Provident Fund to which a maximum of 10 per cent of salary may be subscribed and on which Government pay compound interest at 4 per cent. In this way an officer may put by as much as Rs. 30,000 to Rs. 40,000 by the end of his service of 25 and 30 years respectively. In addition he may look forward to a pension of Rs. 5,000 after a period of active service of 25 years and to one of Rs. 6,000 if he rises to a 1st grade Conservatorship. The above pension and fund money are absolutely all the Forest Officer has to depend on at the end of 25 or 30 years' service in as unhealthy a Department as exists in the country, for it cannot be expected that he can save much more from a salary which, though now sufficient for his domestic and official requirements, is still not so lavish as to allow of the rapid accumulation of wealth after the expenses necessary to his social position have been disbursed.

We have said that the Forest Officer who lives to earn a full pension in India would as a rule retire with a pension of Rs. 5,000 or Rs. 6,000 per annum and with a lump sum of about from Rs. 30,000 to Rs. 40,000. The difficulties then commence and the struggle to maintain a suitable existence in his own country and to educate his children to take their place in a level of society equal to that

in which he himself has lived is accentuated. Another and yet still sadder aspect of the case exists and is brought to notice when officers die on active service leaving widows and children unprovided for. Instances of such have been common enough in the past and such a state of affairs becomes little short of intolerable when it is understood that provision is made in some other scientific Departments to remove these disabilities by adequate pension rules and by widows and orphan funds; if this were more fully recognised in England it would certainly affect the recruitment of the Forest Service very adversely. The case of the improvement of the pension prospects of the Forest Officer is further strengthened by the fact that his work ends with his retirement from the Indian Service. He is unlike the Medical Officer, the Engineer and even the Policeman who all have the prospect of getting remunerative work at Home on retirement.

But while referring to Engineers and Police we deprecate the comparison so often made between the Forest and the latter two Departments. They have little in common at the present day. If a comparison is to be made between Departments we consider it preferable to refer to the Indian Medical Service—a scientific Department as is the Forest, the names of whose members are found in the lists of the great English scientific societies where, however, one may look in vain for those of Engineers and Policemen.

The Medical Officer in addition to his salary has the important privilege of private and often lucrative practice in India. *He has also various local allowances and he can on retirement* continue to work at Home. None of these advantages are possible to the Forest Officer. And in spite of superior emoluments during active service the Pension Rules of the Indian Medical Service show a still more marked superiority to those of the Forest Department. From the 13th August 1903 the commissions of officers of the Indian Medical Service reckon from the date upon which their course of instruction in England begins and from that time all service counts for increase of pay, for promotion and for pension. The salary of the Director-General, Indian Medical

Service, is Rs. 3,000 per mensem and the scale of pension for the Service generally is as follows :—

After 17 years' service £300 per annum.
" 20 " " £400 "
" 25 " " £500 "
" 30 " " £700 "

But besides this the following scale of extra pensions is in force :—

To a Surgeon-General after 3 years' active service as such £350.

To a Colonel after 3 years' active service as such £125.

To a Colonel after 5 years' active service as such £250.

In other words a Surgeon-General or Colonel after 3 years' service can retire on £700 + 350 = £1,050 and £700 + 150 or £850 respectively, whilst a Colonel after 5 years' service can retire on £700 + 250 or £950 per annum.

The Widows and Orphans' Fund provides the following scale of pensions on the death of officers of the Indian Medical Service. For the purpose of calculating the amounts to be paid by each grade the Service is divided into 5 classes comprising—Class I, Lieutenant-Colonels in receipt of Colonel allowances ; Class II, Lieutenant-Colonels; Class III, Majors ; Class IV, Captains ; Class, V, Lieutenants.

The pension due to a widow during widowhood in each class is £160, £130, £100, £70 and £40 respectively. The pensions for orphan children of all classes alike are :—

	From birth till age of 6 years.	From age of 6 years to age of 12 years.	From age of 12 till age of 21 years.	To females only from age of 21 years for life or till marriage.
Amount of pension to each orphan per annum ...	£ 10	£ 20	£ 30	£ 45

The following table shows the monthly contributions payable by every officer according to his class :—

Class of contribution.	By each married officer. Indian rates.	By each married officer. European rates.	By each unmarried officer or widower. Indian rates.	By each unmarried officer or widower. European rates.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Class I	4 15 10	2 7 11	2 8 0	1 4 0
	4 0 0*	2 0 0*	2 0 0*	1 0 0*
Class II	3 16 8	1 18 4	1 10 8	0 15 4
	3 4 0*	1 12 0*	1 5 8*	0 12 10*
Class III	2 17 6	1 8 9	1 3 0	0 11 6
	2 8 0*	1 4 0*	0 19 2*	0 9 7*
Class IV	1 18 4	0 19 2	0 13 4	0 6 8
	1 12 0*	0 16 0*	0 11 2*	0 5 7*
Class V	0 19 2	0 9 7	0 7 8	0 3 10
	0 16 0*	0 8 0*	0 6 4*	0 3 2*

NOTE.—The Europe rates of subscription are payable after retirement and during furlough out of India. An officer on furlough in India and not on full Indian pay will be required to pay only half the Indian rate of contribution.

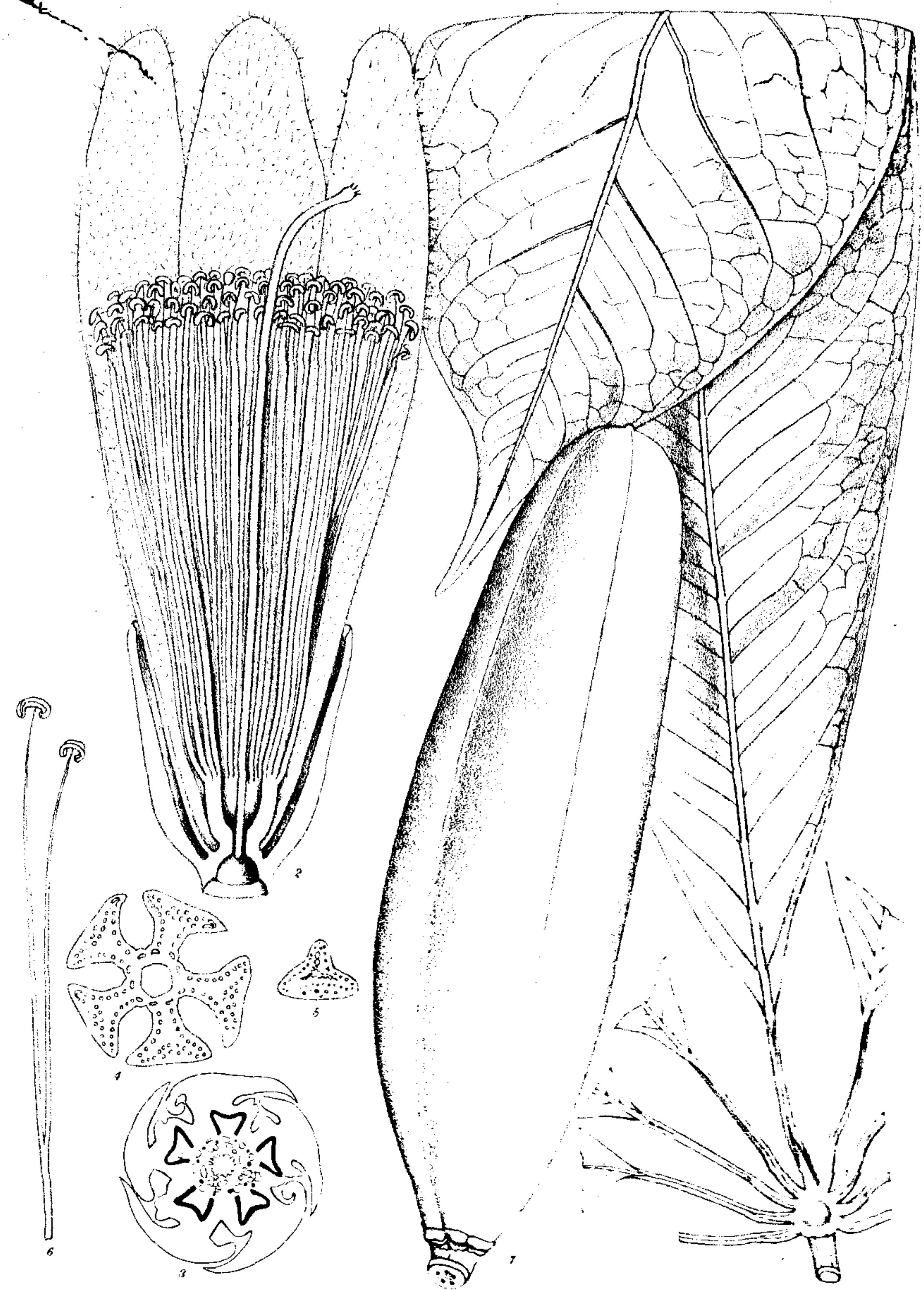
On promotion from Class V to Class IV and upwards officers have to pay a donation to the fund of £10, £20, £30 and £60 respectively. Donations have also to be paid on marriage, re-marriage and on the birth of a child.

The rates of furlough allowances are also liberal being as follows :—

An officer in the Indian Medical Service in civil employ draws the same scale as that drawn by the members of the Indian Civil Service, *i.e.*, a maximum of £1,000 a year and minimum of £500 a year or his last salary whichever is less.

Let these figures be compared with those of the Forest Service whose average emoluments throughout service are lower than those of the Medical Service. About 5 per cent of the whole Department can attain a pension of £525 per annum, the remainder being given some £440 or less. If we turn to the leave emoluments of the two services we find the same startling contrast

* Temporary reduction of $16\frac{2}{3}$ per cent.



Drawn by K. P. Dass. Lith. by S. [illegible]

BOMBAX INSIGNE Wall. Var. typica.

in the pay drawn. A Forest Officer on furlough draws as a maximum only £800 a year and there *is no minimum*. He draws £200 a year or three-fourths of his last salary whichever is less. Consequently the Forest Officer can only take leave when he has saved up sufficient to enable him to live during the period he is at Home. This is surely a curious and anomalous position of affairs.

There is no provision save the Provident Fund for widows and orphans for whom this Fund is avowedly not calculated to afford any permanent relief. The furlough allowances are less and the pension rules manifestly incomparably inferior. We need say no more, for these statistics will, perhaps, afford our readers some surprise and much reflection, which we trust may, in the future, have some useful influence on the conditions of service in the Department.

SCIENTIFIC PAPERS.

THE VARIETIES OF BOMBAX INSIGNE *Wall.* IN BURMA.

BY A. T. GAGE.

For some years Mr. F. B. Manson, lately Conservator of Forests, Tenasserim Circle, contributed many interesting botanical specimens from Tenasserim to the Herbarium of the Royal Botanic Garden, Calcutta, and Mr. Manson's successors have continued those contributions that are likely to prove exceedingly interesting, as coming from a region the vegetation of which is very imperfectly known, but as far as one's knowledge does go, appears to show a remarkable difference from the adjacent Malayan Peninsula Flora. Unfortunately, pressure of official routine, and the absence of any assistance for some considerable time have prevented the writer from giving to purely botanical work other than odd moments. Amongst the specimens to which the writer

has been able to give some attention, however, is a series of collections of *Bombax insigne* Wall. The writer's attention was first directed to the study of this species by his finding on the Arracan Yomahs in the Minbu district of Upper Burma, the fruit of a Bombax which was obviously not that of *B. malabaricum*, and certainly did not agree with the description of the fruit of *B. insigne* as given by Wallich and in the Flora of British India. The fruit of this unknown Bombax was mentioned in the writer's account of the Vegetation of the District of Minbu (*Rec. Bot. Surv. Ind. iii*, No. 1, 1904), and Mr. Manson seeing it mentioned, kindly forwarded what specimens he or his officers collected to the Calcutta Herbarium. His collections have since been supplemented by Mr. Branthwaite, the present Conservator of Forests of the Tenasserim Circle.

The varieties of *B. insigne* have been distinguished by Lieut. Colonel Prain in his paper on the Flora of Narcondam and Barren Island (*Journ. Asiat. Soc. Beng. lxii*, 1893). In that paper Colonel Prain writes that the material then available was incomplete. As the specimens from Tenasserim at the present writer's disposal supplement Colonel Prain's material and are in particularly good order for the most part, with flower specimens preserved in alcohol, the writer is of opinion that it may be useful for Forest officers and others to have fairly full descriptions of the varieties which have been sent to the Calcutta Herbarium from Burma. Before proceeding to do so, however, it may not be amiss to describe the general structure of the flower and particularly the arrangement of the stamens, which differs in the various forms and readily serves to distinguish them.

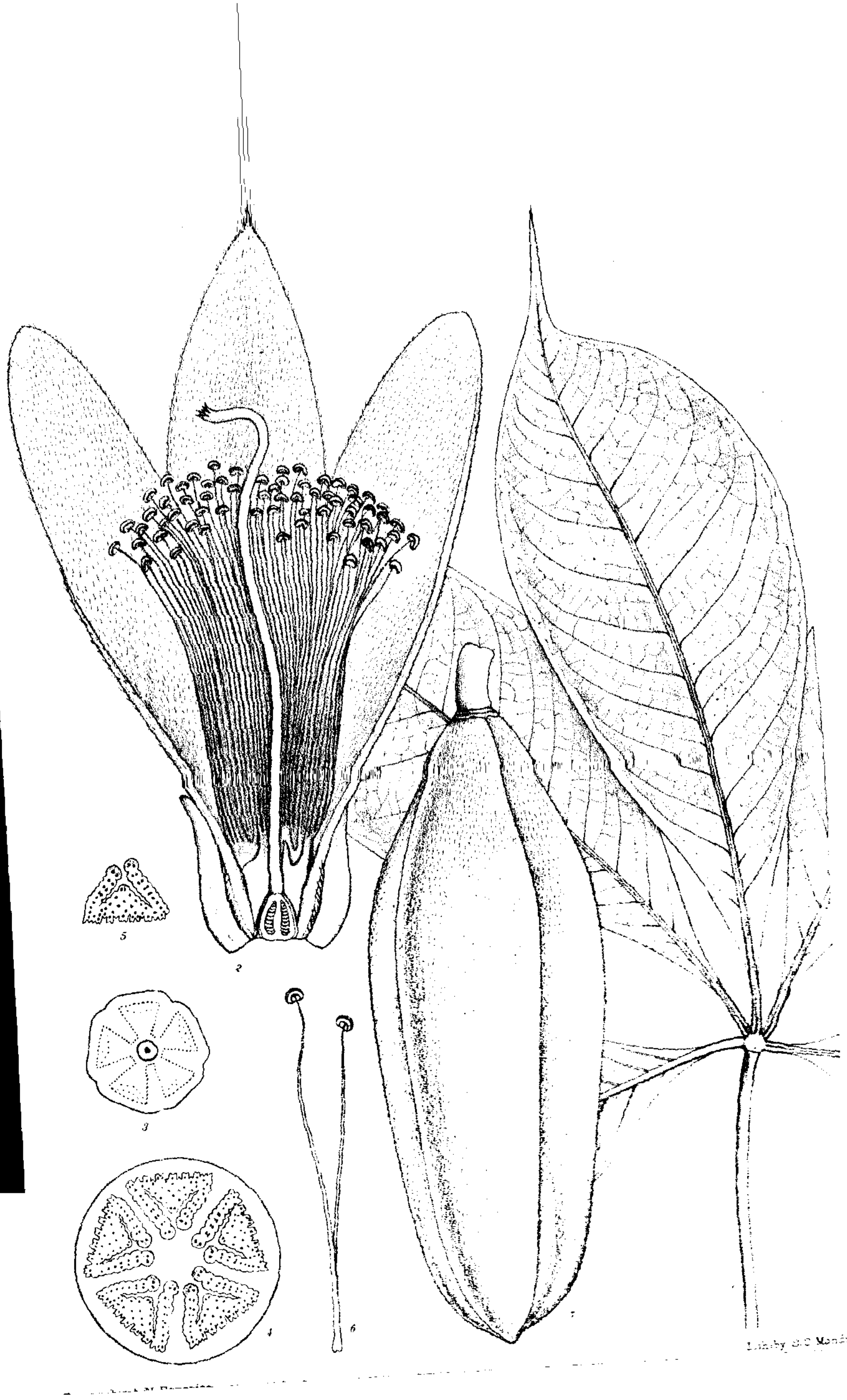
The flowers are of large size, from about 8 to 14 cm. in length. The calyx in the bud is ovoid or subglobular, entirely concealing the petals at first, afterwards rupturing at the apex by two or three irregular rents which extend down the calyx some distance. The five petals are strongly imbricated at the base, either overlapping uniformly to the left or quincuncial, spreading upwards in the flower.

The stamens are arranged in five bundles or phalanges, with an inner series forming a ring surrounding the style. The structure of the phalanges and the arrangement of the stamens are best made clear by making a series of transverse sections of the flower from the base upwards. A section through the extreme base shows a solid disc composed of the fused calyx corolla and base of ovary. A section slightly higher up shows two circles, the calyx and corolla, surrounding the ovary. A section a little higher up shows the calyx a loose ring and within it and surrounding the style is a thick ring with five irregular well-marked ridges separated by as many furrows. This ring or disc is composed of the united bases of the staminal phalanges which have begun to separate peripherally while still united just around the style. Each ridge is the base of a phalange, to the outer side of which a petal is adherent. (Pl. 11, Fig. 3). The petals viewed from the side are seen to overlap each other to the left. Each phalange shows in its centre a dark triangle indicating the fused vessel bundles, which spread out above into the separate filaments. At the apex of each triangle near the style are two dark spots which indicate the bundles which go to supply the circumstylar ring of stamens. Surrounding the lumen of the tube for the passage of the style is an irregular ring of glands (Pl. 11, Fig. 3). A section a little higher up still, shows the phalangeal column quite free of the petals and the five phalanges that form the column very evident, separate peripherally but still united round the style. Each phalange is still a solid trigonous body. The lines forming the black triangles of the lower section have now in each phalange opened out into separate dots each representing a vascular bundle (Pl. 11, Fig. 4). The circle of ten vascular bundles immediately surrounding the style is also quite evident. A section still higher up shows the phalangeal ring just held together by the circumstylar filaments, while each phalange now shows a central tri-radiate cleft, which divides the phalange into two lateral wings or legs, and a central portion, referred to by Colonel Prain respectively as the crural and intercrural components of the phalange (Pl. 11, Fig. 5; Pl. 13, Fig. 6). Higher up still the circumstylar filaments separate

entirely from the phalanges while in each phalange the tri-radiate cleft now completely divides the phalange into a central intercrural part and two lateral crural parts. (Pl. 12, Fig. 5, and Pl. 13, Fig. 7). The number of stamens in the crural and intercrural parts of the phalange and the appearance of the phalange on transverse section are points which help to distinguish the different varieties. The phalanges may be united only to quite a short distance above the ovary without forming a markedly distinct column, or, they may form a very distinct column above the ovary. In the former case the phalanges diverge without any angle to speak of from their basal junction, in the latter case they are given off from the column at a very distinct angle. Fig. 2 of Plates 11 and 12 illustrate the first, and Figs. 2 and 9 of Plate 13 illustrate the second method. The three parts crural and intercrural of each phalange finally break up into the staminal filaments. Usually the filaments are binate, dividing near their emergence from the general mass of the phalange (Fig. 6 of Plates 11 and 12). In the var. *vera* of sub-species *anceps*—to be presently described—the filaments often emerge singly. In all cases the anthers are unilocular.

The ovary is conical, 5-chambered, with usually 4 vertical rows of ovules in each chamber. The style which surmounts the mass of stamens ends in a somewhat capitate stigma with 5 short teeth or minute recurved lobes.

In describing the various forms the writer follows Col. Prain's classification in the main. He is, however, unable to agree with Col. Prain in considering the specimens in the Calcutta Herbarium collected by Oliver at Katha in Upper Burma—which are presumed to be the same variety as described by Pierre in his *Flore Forestière de la Cochin-Chine*, under the name *Bombax cambodiense*—as a variety of the sub-species *genuina*. The writer is of opinion that the length of the staminal tube or the relative number of stamens in the crural and intercrural parts of a phalange are not of so much importance as the way in which the phalanges are given off. A glance at Fig. 9 of Pl. 13, which is accurately drawn from one of the flowers collected by Oliver at Katha, shows in the writer's opinion that what he—following Colonel Prain—here calls var.



Lith. by S. C. Mondul.

cambodiensis is nearer in the morphology of its flower to sub-species *anceps*, var. *vera* (shown on the same plate), than to any of the other varieties represented from Burma. The number of the intercrural stamens does not appear to be of very great importance as a distinguishing character as it is the same in subspecies *anceps* as in the majority of the varieties of sub-species *genuina*.

The sub-species or varieties of *Bombax insigne* sent from Burma so far are :—

I.—Sub-species **genuina** Prain (*Journ. Asiat. Soc. Beng. lxii*, 1903).

(*a*) Var. *typica*.

A tree which may reach a height of from 15-30 m. and a trunk circumference of 2·5—6 m. Bark more or less covered with stout conical prickles. The leaves compound digitate with 5-12 leaflets. Petiole may reach to 60 cm. in length. Leaflets vary much in size, lanceolate acuminate, subsessile or shortly petioled, glabrous, glaucescent beneath, main lateral nerves about 16 on each side of the midrib. Calyx about 3 cm. long, external diameter about 2·5 cm., adpressedly silkily hairy internally. Petals red, about 14 cm. long and 2 cm. broad, tomentose on both surfaces. Staminal phalanges separating from the short indistinct column without a marked angle of divergence. Phalanges beaked on transverse section. Circumstylar stamens 20. Stamens in each crus of a phalange 16—20, intercrural stamens 32—40. Filaments binate, slender, about 10·5 cm. long. Ripe capsule 15—20 cm. long and about 4 cm. in diameter, almost cylindrical, without well marked ridges.

Chittagong, *Schlich !* ; Taong Dong, *Wallich !* ; Pegu Yomahs, *Kurz* Nos. 1238, 2105 ! ; Bhamo, *J. Anderson !* ; Arracan Yomahs, *Shaik Mokim !* ; Tounggoo, Tenasserim ; Shewgun, Salween river in Thaungyin Forest Division ; Bama Choung, Zadi Forest Circle ; *Forest Department Collectors !* ; Hsipaw, Northern Shan States *Burkill* No. 24138 ! ; Thawatti, Yamethin District, *Aubert !* ; Ponakwyau, Arracan, *Sheik Ismail !*

Vernacular names are 'Didu-pyu' (*Tenasserim*), 'Shiu' (*Tavoy*), and 'Sit-pan bewip' (Northern Shan States), 'Didok-kokhe' (Yamethin).

Plate 11—*Bombax insigne*, Wall., sub. sp. *genuina* Prain, var. *typica*.

Fig. 1. Leaf showing portion of petiole, bases of eight leaflets, and one entire leaflet. Fig. 2. Longitudinal section of flower. Fig. 3. Transverse section through base of flower with calyx and style removed. Described in the text. Fig. 4. Transverse section through phalanges while still united round the style which has fallen out of the central lumen. Fig. 5. Transverse section through single phalange showing the triradiate slit dividing it into crural and intercrural parts. Fig. 6. Binate stamen. Fig. 7. Fruit. Figs. 1, 2, 6, 7, natural size. Figs. 3, 4, 5, enlarged.

This variety is distinguished by the long slender appearance of the flowers compared with those of the other varieties. Compare figures in the plates accompanying this paper. The shape of the transverse section of the phalange is noteworthy. The fruit is considerably longer than the fruit of the other varieties here described. Mr. Manson states that the wood, which is used at Toungoo chiefly for making coffins, is firmer in texture, stronger and easier to work than that of *Bombax malabaricum*.

(*b*) Var. *Wightii* Prain.

A large tree with more or less prickly bark. Leaves long-petioled, 30 cm. or more. Leaflets 5—6 or more, oblanceolate, acuminate, glabrous, shortly petiolulate or subsessile, including petiolule 20 cm. or more long, 8 cm. or more in breadth. Lateral nerves 20 or more on each side of the midrib. External diameter of calyx about 3 cm., length 4—5 cm. from basal constriction, adpressedly silkily hairy internally, with basal glands externally. Petals red, about 9 cm. long and 3 cm. broad, adpressedly tomentose on both surfaces, overlapping to the left or quincuncially imbricate. Staminal column quite short, phalanges without any angle of divergence from the column, triangular on cross section, dentate peripherally, consisting of 20 stamens in each phalangeal crus and 50 intercrural stamens. Circumstylar ring of 20 stamens. Filaments binate in the specimens examined, slender, about 7·5—8 cm. long from base of the staminal column. Ovary conical, glabrous, style cylindrical, glabrous. Stigma starlike with triangular lobes. Ripe capsule about 13—18 cm. long, about 5 cm. in diameter, without well marked ridges and furrows. Seeds pyriform compressed, 8 mm. long, 5 mm. broad.

Burma: Shwegyin, Tenasserim, *Manson !* **S. India :** North Kanara, *Talbot* No. 2818 ! *Herb. Wight.* K.D. No. 218 ! Malabar, Concan, *Stocks Law ! Herb. Ind. Or. Hook. f. & Thoms !*

Burmese 'Didu.'

Plate 12—*Bombax insigne* Wall., sub. sp. *genuina* Prain, var. *Wightii.*

Fig. 1. Leaf with portion of petiole. Fig. 2. Longitudinal section of flower. Fig. 3. Transverse section through base of staminal column. The dots which are the fibrovascular bundles going to supply the stamens, outline the fused phalanges very distinctly. Fig. 4. Semi-diagrammatic transverse section across the separated phalanges. Each phalange now shows very distinctly its crural and intercrural components. The dots are fibrovascular bundles. The intercrural part is curiously indented peripherally. Fig. 5. Transverse section of a single phalange. Fig. 6. Binate stamen. Fig. 7. Fruit. Figs. 1, 2, 6, 7, natural size. Figs. 3, 4, and 5, enlarged.

This variety has not hitherto been sent from Burma. It is but poorly represented in the Calcutta Herbarium, but the Burmese specimens agree exactly both in leaf and flower with the South Indian ones. Seen alongside of var. *typica*, the external appearance of the flowers alone is sufficient to distinguish the two.

II.—Sub. sp. **anceps** Prain.

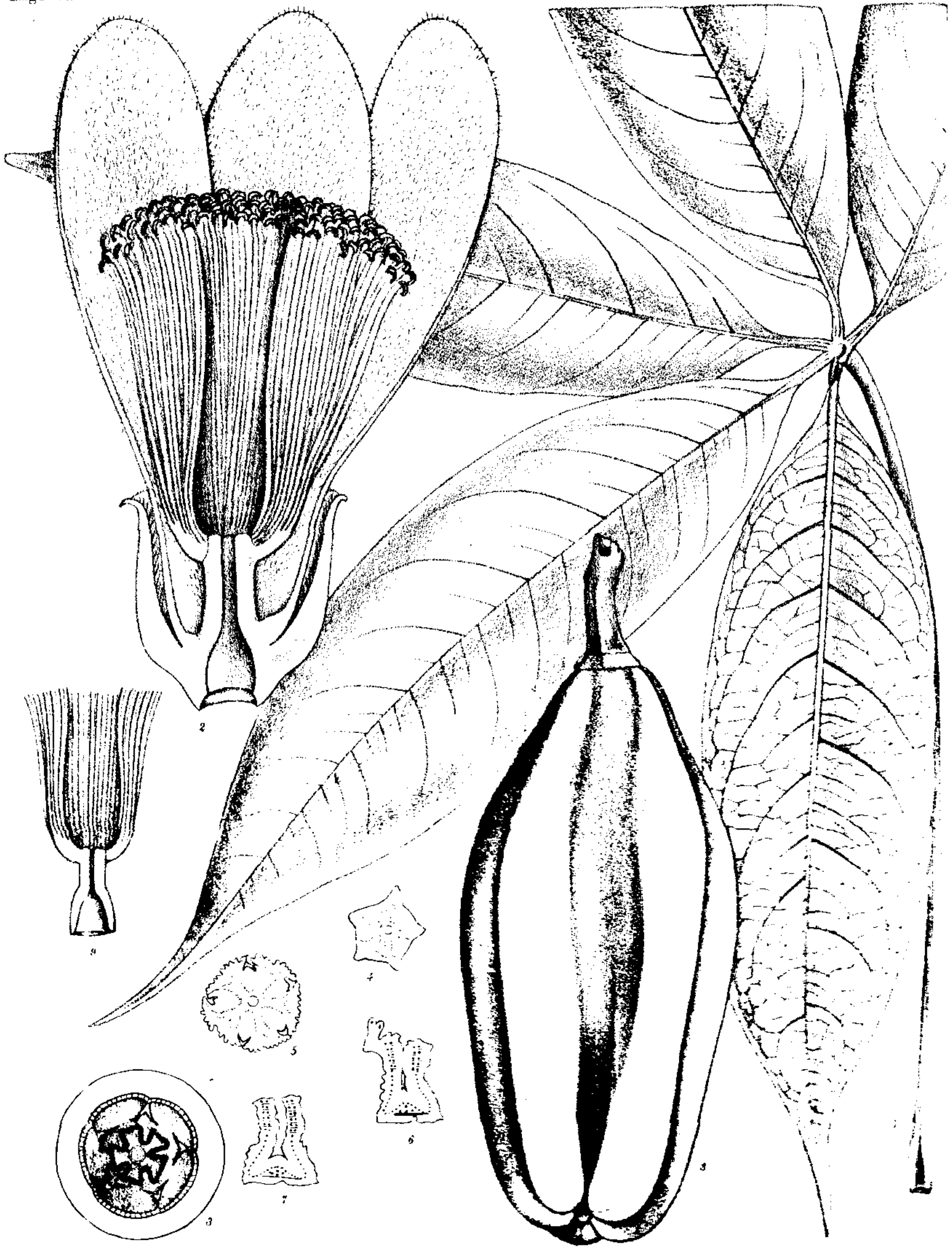
(*a*) Var. *vera.*—B. anceps *Pierre.*

A lofty tree, reaching when mature to 30 m. in height and at least 5 m. in girth. Bark greyish, more or less prickly especially when young. Leaves petioled, 5—7 foliolate, leaflets subsessile, oblanceolate, varying greatly in size, entire, acuminate, base tapering, glabrous except for a few minute hairs on midrib near the base, dark green above, light green beneath in young leaf, length of leaflets (probably not mature) 8—16 cm., breadth 3—4·5 cm., petiole 9—14 cm., lateral nerves 10—15 on each side of the midrib. Flowers on very short stout pedicels. Calyx wall about 3·5 mm. thick in bud, eglandular, densely adpressedly silkily hairy internally, splitting into 2—3 irregular lobes, length from basal articulation to apex about 6 cm., external diameter 3—3·5 cm. Corolla red (or white), petals densely tomentose on both surfaces, oblong, narrowed at the base, about 8·5—11 cm. long and 2·5—4 cm. broad. Prefloration twisted to the left or quincuncial. Staminal bundles united to form a column about 2·2 cm. long from the base of the corolla, then diverging at a very distinct angle into

5 phalanges. Phalanges oblong in transverse section. In each phalange intercrural stamens 28—30, crural stamens about 40 in each crus. Circumstylar ring of stamens not very clearly distinguishable except in cross section. Filaments usually single, but may be binate, rather stout, about 6 cm. long. Ovary cupular slightly tomentose, style glabrous, cylindrical, 10 cm. long, surpassing the stamens. Stigma 5-toothed. Ripe capsule woody, dark brown, 8·5—10 cm. long with five very prominent rounded ridges opposite the loculi, diameter from ridge to opposite furrow 4—4·5 cm. Seeds ovoid compressed, about 5 mm. in diameter and 8 mm. long.

Kawpok, Salween district near Papun on the Dagwin road, Tenasserim, *Forest collector!* Zadipon, Sabyin Reserve, and Minye, Saing Yane Reserve, Toungoo, *Watson!* Kwingyi, Tawpyun Forest, Tenasserim, *Forest collector.* Pegu Yomahs, *Kurz* Nos. 1239, 2106! Heho, Southern Shan States, *Abdul Khalil* and *Abdul Huq!* Nwamadaung hills, Arracan Yomahs, Minbu District, Upper Burma, *Gage!* Myohla and Myaung-myaik, Yamethin District, *Aubert!*

Vernacular names are Burmese 'Didu-pyu,' 'Didokpin' Karen 'Kowa.' Mr. H. W. A. Watson, the Deputy Conservator of Forests, Toungoo, states that this species loses its leaves early in December, flowers in the end of that month and beginning of January, fruits in April, and sends out leaves again about the end of May. Colonel Prain describes the flowers as *white.* Pierre states that his recollection is that they are *red.* The Kawpok specimens are said to have had *white* flowers, those from Zadipon *red* flowers. Probably the colour varies and the writer is inclined to think that Wallich's *albiflora* variety of *Bombax malabaricum* is the white flowered form of this sub-species. Whatever the colour of the flower the long staminal column, giving off its phalanges at quite a sharp angle and the comparatively stout filaments and short broad petals and glabrous leaves make this variety easily distinguished. There seems little doubt that this is the plant which Pierre found in Cochin-China and published in this *Flore Forestière* as *Bombax anceps*, and as to whether it is not worthy of specific rank is a matter of opinion, which, however, it is unnecessary to discuss here



Drawn by K. P. Dass.

Lith. by S. C. M...

BOMBAX INSIGNE Wall. Sub. sp. ANCEPS

Plate 13.—*Bombax insigne* Wall., sub. sp. *anceps* Prain, var. *vera.*

Fig. 1. Leaf (immature). Fig. 2. Longitudinal section of flower. Fig. 3 Transverse section through base of flower just above the ovary showing calyx ring (unshaded), fused corolla and staminal column, (shaded). Outline of the phalanges shown by the wavy dark band composed of the fused fibro-vascular bundles. Style in the centre. Fig. 4. Transverse section of staminal column, showing the phalanges outlined by dots which are the fibro-vascular bundles going to the stamens. Fig. 5. Transverse section through the staminal column about the level of the divergence of the phalanges. Fig. 6. Transverse section of a single phalange, showing portion of the circumstylar ring with two fibro-vascular bundles, the slit just evident. Fig 7. Transverse section of the same higher up, where the circumstylar ring of stamens has separated off. Note the oblong shape of the phalange, and the distinct division into crural and intercrural parts. Fig. 8 Fruit. Fig. 9. *Bombax insigne* Wall., sub. sp. *anceps* Prain, var. *cambodiensis*. Staminal column and stamens, the latter cut short. From one of Oliver's specimens in the Calcutta Herbarium. Compare with Fig. 2.

Figs. 1, 2, 8, 9, natural size. Figs. 3, 4, 5, 6, 7 enlarged.

(*b*) Var. *cambodiensis.*—B. cambodiense *Pierre.*—The Burmese specimens of this variety have the flowers too fragmentary to allow of a complete description being drawn up from them so that the following is partly adapted from Pierre's description in his *Flore Forestière.*

A tree 20—25 m. high, with grey bark and branches covered with conical spines. Leaves usually 7-foliolate. Petiole 20—30 cm. long. Leaflets subsessile or shortly petioluled. Lamina oblanceolate, acuminate, glabrous on the upper surface, covered with a fine greyish tomentum on the lower, 15—28 cm. long, 6—12 cm. broad, lateral nerves about 20 on each side of the midrib. Calyx tomentose externally, adpressedly silkily hairy internally, about 5 cm. long and 3 cm. in external diameter. Petals tomentose on both surfaces. Staminal column very distinct with the phalanges diverging at a marked angle, each phalange with about 30 intercrural stamens and 20 in each crus. Ovary (in bud) pubescent and style (in bud) covered with long stellate hairs. Fruit unknown.

Katha district, Upper Burma, *Oliver!* Province of Tran, Cambodia, *Pierre!*

The material of this variety is very scanty and incomplete, but so far as it goes, the flowers appear to be considerably smaller

than those of var. *vera*. Pierre's figures unfortunately show the flowers only in the bud stage. The tomentose under surface of the leaves is a distinctive character. Pierre writes of the leaflets as having 30–40 nerves, but his figures show only about 20 on each side of the midrib. Possibly he includes the nerves on both sides of the midrib in his enumeration.

The following key may be useful in helping to distinguish the Burmese varieties so far known :—

Staminal tube a very distinct column with phalanges coming off at a distinct angle. Intercrural stamens in each phalange, 30 ...	Sub. sp. *anceps* Prain.
Stamens in each crus of a phalange 40. Filaments often single. Leaves glabrous ...	... Var. *vera*.
Stamens in each crus of a phalange 20 (*Prain*). Filaments binate. Leaves pubescent beneath ...	Var. *cambodiensis*.
Staminal column very short and indistinct, breaking up into phalanges without any angle of divergence	Sub. sp. *genuina* Prain.
Intercrural stamens in each phalange 30—40. Petals 14 cm long, 2 cm. broad. Fruit 14—20 cm. long, 4 cm. in diameter ...	... Var. *typica*.
Intercrural stamens in each phalange 50. Petals 9 cm. long, 3 cm. broad. Fruit 13-18 cm. long, 5 cm. in diameter	... Var. *Wightii*.

In addition to the varieties described in this paper as coming from Burma, Colonel Prain in his paper in the Journal of the

Asiatic Society of Bengal describes four other varieties of subspecies *genuina*, and as it is possible that anyone or all of those may occur in Burma mention may be made of them here. They are :—.

(1) Var. *alba*.—This appears to be very like the ordinary *B. insigne* but with white flowers. Cultivated in Java, possibly wild in Burma.

(2) Var. *andamanica*.—This variety, so far found only in the, Andaman islands, differs from the ordinary *B. insigne* in having narrower leaflets.

(3) Var. *polystemon*.—The intercrural stamens of each phalange in this variety number about 90. So far it has been found only in Narcondam island.

(4) Var. *larutensis*.—In this variety there are only ten stamens in each crus of a phalange. Flowers turning green. In the Malay Peninsula.

The writer has pleasure in expressing his thanks to the officers of the Tenasserim Circle for the interest they have shown and the trouble they have taken in sending him such excellent specimens. His gratitude, it must be confessed, to some extent comes under the description of being a sense of favours yet to come, for the present paper makes it obvious there is still opportunity to increase our knowledge of the Burmese species of Bombax, and any specimens which Forest officers or others may send to the Calcutta Herbarium will be thankfully acknowledged. It is of course impossible to collect leaf flower and fruiting specimens from the same tree at the same time, but it should be possible in favourable circumstances to mark some particular trees and collect leaf flower and fruit specimens in their appropriate seasons, from the same tree. Buds and flowers, the latter collected if possible while still on the tree, should be put in 50 per cent alcohol, and sent in addition to the ordinary pressed specimens. Any notes regarding height of tree, circumference of trunk, colour, prickly or smooth character of bark, frequency, times of leafing flowering, and fruiting colour of corolla, calyx, vernacular names, etc., would add greatly to the value of any specimens sent.

ORIGINAL ARTICLES.

THE PRESERVATION OF KARACHI HARBOUR.

THE CONTROL OF THE INDUS.

BY G. K. BETHAM, I.F.S., RETD.

Sir Charles Dilke on the occasion of his visit to Karachi early in 1889 was much struck with the great expansion of the place, especially with regard to its shipping industry, but—and this is a very large but—he wrote, "*the bar which formerly existed has been removed at enormous labour and replaced by another almost as evil, though enough sand has been dredged out of the harbour as would make a local Himalaya if it had been properly utilised.*" No doubt the Indus is a difficult river to manage; it is, however, very probable that a tithe of the money spent in dredging the harbour, if expended on the preservation and protection of the banks and head-waters of the mighty stream and its tributaries, the Jhelum, the Chenab, the Ravi, the Sutlej and the Beas, would have kept the Harbour freer of silt than it now is, and, at the same time, have saved Government many thousands of rupees.

The yearly deposit of silt in Bombay Harbour is something incalculable. Mr. Aitken, at one time Engineer to the Port Trust of Bombay, writes to the *Times of India* as far back as 1886 and says: 'There was deep water in Bombay Harbour *only where there was a rapid current to keep the channel open.*" In the six years 1883-84 to 1888-89 over nine lakhs of rupees were expended upon dredging operations: one quarter of this sum would have effectually secured the protection of the area which drains into the Harbour and, at the same time, a splendidly productive property would have been secured to the owners, be they the Port Trust or the Government. Warning surely may be taken from Cambay, Diu and other coast ports, and from the tidal creeks in Kolaba and Ratnagiri harbours and water-ways, once largely availed of by commerce, now almost entirely closed against it.

In 1899 at the time of the Viceroy's visit to the North-Western Frontier, the city of Dera Ghazi Khan came very prominently into

notice, as it was in imminent danger of being swept away bodily by the river Indus. Various plans for the preservation of the town and cantonment had been adopted, and the one that was then under trial was a scheme for the protection of the foreshore by means of large iron crates filled with stones. This plan, however, did not commend itself to all, as many thought that the river was almost sure to sweep away the crates, and it was therefore suggested that the form of protection hitherto in use, that is, loose stone pitching, should be continued and, at the same time it was recommended that a short line of railway should be constructed to the foot of the hills so as to provide a means for the retreat of the population, should the situation become acute. The fears as to the stability of the crates full of stones were well founded. They were swept away and Dera Ghazi Khan must have gone, but that, just as all hope of saving it had been abandoned, the waters subsided. Another instance of the futility of attempting to bridle the river by engineering works, *pure and simple*, is to be seen in the lower Indus, on the left bank, some little distance below the ancient town of Tatta. Here a stretch of bank was faced with Mangalore tiles, at a very considerable expense : the tiles stood out for some little time, two or three years, and then the river discovered a weak spot and—the tiles have gone. The vagaries of the Indus are endless ; the Fuleli canals and the canals known as the *Kamal-wah* and the *Imam-wah-khokar* follow abandoned beds, and there is a story to the effect that a bridge built over the river, once upon a time, is still to be seen standing high and dry bridging a waterless channel, while the river flows at some distance from it. As matters stand at present, everything on the banks, save what is—or what is termed—permanent bank, like the stretch at Jerruck, is at the mercy of the stream. The question then is, what can be done ? The problem should be pondered over and solved. There must be some way of controlling the Indus, of keeping it within some defined limit and of safeguarding the valuable property along its course ; at present, towns, villages and thousands of square miles of culturable land are in perpetual danger of being obliterated. Up to the present these calamities have

not attracted much attention; they are on what may be termed a small scale, but they bring great misery and much distress on the small farmers, a class which bows in voiceless submission to the river god, to the decrees of—what they consider—fate. Should Dera Ghazi Khan go, or any catastrophe of any dimension occur, public feeling would be aroused, and the question would then receive greater attention than it has received up to the present time. District Officers have done, and are still doing, what they can; but their efforts must unavoidably be limited to small areas comparatively, in other words, they must be spasmodic. The question should be taken up on a comprehensive scale by Government. Local Governments are not always able to move in such matters on their own initiative, however willing they may be at heart to do so. A general and far-reaching system of control is imperatively called for. The Committee on the Dera Ghazi Khan defence works recommended that any place for the protection of the river face by stone should be accompanied by a *system of foreshore reclamation*, and that this system should be worked by the irrigation officers, who were best fitted to deal with the matter. Some of the local irrigation officers have worked at the reclamation of lands, and, by means of closing certain creeks and encouraging the deposit of silt in traps formed by surface embankments, they have succeeded in controlling the river in a very great degree over considerable distances. The river has retired for miles in various parts and the stretches of land thus reclaimed have become once more fit for cultivation. But more than this is needed. The question of the control of the Indus must be taken up as a whole, and not piecemeal.

This view was apparently taken by Government, for an officer of the Public Works Department, Mr. Dawson, was deputed some years ago to America to study the system of river control in vogue there. He commenced work on the Indus, but died before attempting anything very definite. This is the more to be regretted as there appears to be a strong resemblance between the Mississippi and the Indus. The caving banks, the sand banks and the shifting channels, the bayous, creeks and embankments are features

common to both rivers. The Americans have paid great attention to the difficulties which face them on the Mississippi, and no doubt there is much to be learned from them. *Vegetation properly utilised* ought to play an important part in any scheme for the control of the river, for the consolidation and fixing of its banks : no attempt has been made, so far, to enlist this agency : the Dera Ghazi Khan Committee may have had it in view when they recommended a *system of foreshore reclamation*. The *kachas*—as the new deposits, brought down and formed by the river are named in the vernacular—should be taken in hand and treated systematically ; at present they are left to nature to be clothed with forest growth and it is marvellous to see how quickly nature does the work : and if nature were assisted results would be still more startling. The tamarisks *(T. gallica* and *T. dioica)* and the bahan *(Populus euphratica)* spring up spontaneously on these *kachas* with astonishing rapidity, and the deposits are very soon covered with tree growth. It would be essential to take these *kachas* into consideration in any general scheme for the control of the river and to adopt measures for perpetuating such of them as in such general scheme it might be deemed necessary, or advisable, to preserve ; at present they are completely at the mercy of the river and are swept away even more rapidly than they are thrown up. It would be useful to assist this natural reproduction by planting grasses and reeds, more especially those possessed of long and binding roots, such as elephant grass (*Typha elephantina*), *dub* grass (*Eragrostis cynosuroides*) and *chabar* (*Elensine ægyptiaca*) which are indigenous : *dub* and *chabar* are to be found in profusion on the *bunds* of the Irrigation Department. They need to be planted along the banks of the river as well : the convolvuli such as *Ipomœa biloba*, the goat's foot creeper (*I. hederacea*) and the deer's foot convolvulus (*C. arvensis*) would also be very useful : then there is the *Paspalum dilatatum* which has been most successful in Australia as a fodder plant or pasture grass, and which drives its roots deep down into sandy soil and thrives well in such a situation : there is also the Danish *Marchalm*, a grass which has been tried with great success on the Skagen coast of Denmark. This grass

is grown upon the sand dunes, where it thrives, shooting down its roots to a great depth and binding the grains of sand together. In a few years the nature of the sands is so far changed that firs can be induced to grow upon them, and thousands of acres of heretofore barren sand have been converted into forest. Great success has also followed the efforts to consolidate the sand dunes of Charente-Inferieure, of Rè and of Oléron in France, and there does not seem to be any reason why similar results should not be obtained in Sind.

The best plan to adopt in approaching the problem of the control of the Indus would be to employ the agency of the Forest Department, through an experienced Forest Officer acquainted with the river, to consolidate and plant the banks, and this should be supplemented by engineering works, not only of embankments, but also of canals leading off surplus flood water at suitably selected spots. In the present condition of affairs thousands of rupees worth of valuable forest property is annually swept away: above and beyond the actual monetary loss thus caused, there is the further loss and also damage to river navigation caused by snags, floating timber, etc. With the Indus under control and its irrigation thoroughly developed, the Indus valley would become one of the richest and most prosperous of countries and one, too, free from the recurring risk of famine, dependent, as it is, on the perennial melting of the Himalayan snows and not on the capacious rainfall of the monsoon. Finally, the efficient control of the Indus affects very materially the well-being of the rising port of Karachi; it is one of the most important points to be considered in connection with the preservation and improvement of its Harbour.

THE SAND PROBLEM AT KARACHI.

The *Times of India* of the 19th November 1904 (*Mail edition*) has an article on the development of Karachi and, amongst other matters, touches on the sand-hills near Clifton and gives the existence of these sand-hills as a reason for the unwillingness of the people of Karachi to resort to that place. The writer of the article does not, in any way, take the sand-hills seriously; he merely

says that "the clouds of microscopic sand which are lifted when a strong wind is blowing make life at Clifton burthensome." These sand-hills are, however, a much graver source of trouble to Karachi than the one thus lightly spoken of. They have been marching steadily on for years and have gradually obliterated roads and landmarks. Go to old Ghigri, north of Clifton, and note what has happened there: all traces of the old Ghigri, which was a busy place in the days of the old Indus Flotilla, have gone; nothing is to be seen of the buildings, workshops, etc., of those times, when old Ghigri was the port of arrival and departure of the Flotilla steamers; all are covered by the irrepressible sand. Forever and forever, steadily, relentlessly, unceasingly the sand is blowing in from the desert shores that stretch away to the south and insensibly, but nevertheless surely, advancing and enveloping everything. The drift is now said to be practically stopped by the planting of the goat's foot creeper (*Ipomœa biloba*) and by preventing all animals from wandering on the dunes. This may be so, but I have my doubts, as the supply of wind-borne sand is unfailing: the creeper may, to a certain extent, control it, but the store of sand is unlimited, and unless some measures are adopted to cut off the supply, or to prevent the deposition of the sand, it will go on accumulating, the dunes will grow higher and higher, until, eventually, they become insupportable. As has been mentioned "the drift of sand is said to have been practically stopped," what then is the meaning of the statement made by the correspondent of the *Times of India* that "the clouds of microscopic sand which are lifted when a strong wind is blowing make life at Clifton"—otherwise a most desirable sea-side resort and hot-weather sanitarium—"burthensome?" Go south of Karachi to the sandy shore stretching away for miles beyond Véti Bandar and see for yourself whence the sand comes and how inexhaustible is the *fons et origo mali*. *This* is whence come "the clouds of microscopic sand which make life at Clifton burthensome."

This sand encroachment at Clifton attracted the attention of Sir Evan James, when Commissioner in Sind, and he submitted the question for the opinion of Messrs. G. W. O. Dunn and

C. N. Clifton, the then Superintending Engineers of the Indus Left and Right Bank Divisions, respectively, of Mr. W. G. Betham, then Conservator of Forests, Sind Circle, and of Mr. E. Jackson Port Engineer of Karachi, and the opinions rendered by these gentlemen were ably discussed and summed up by Mr. J. Forrest Brunton, Secretary and Engineer to the Municipality. Mr. Dunn was of opinion that the accumulation of sand would probably cease, in the course of years, from natural causes, and therefore he did not think it necessary to adopt any preventive measures. Mr. Jackson considered that "the material deposited on Clifton beach comes from the delta of the Indus and not from Karachi Harbour, and also from the stretch of sandy coast, having shallow water and sand banks reaching a considerable distance seawards beyond the natural line of coast, commencing above Ghigri and extending northwards over the mouths of the Indus from the littoral of Mirpur Sakro Taluka," and this conclusion is the one arrived at likewise by Messrs. Betham and Brunton and is undoubtedly a correct diagnosis of the situation.

But it is not only the accumulation of sand which has to be considered, there is also the greater problem of the silting up of, and consequent diminution in, the capacity of Karachi Harbour. Surely a very considerable problem, nay, more, an absolutely vital one for the future well-being of the Port. It may be, as Messrs. Brunton and Dunn think, that Clifton Bay will gradually get silted up and eventually become, through natural causes, the "Back Bay" of Karachi. "As the bay gets silted up the material, which is now carried into the comparatively still back-water behind the Keamari Groyne and is then deposited, will come to be carried past in suspension." And what then? It must be remembered that the supply of flying sand is inexhaustible; it is stated that the major portion of the sand and silt which is now deposited at Clifton comes from Karachi Harbour: this may be true, but it comes to Karachi Harbour from the sandy shores of Mirpur Sakro and from the Indus. There is no use in blinking the question, the detritus comes from somewhere, and I believe we have traced its first causes, consequently the very existence of

Karachi Harbour is threatened : the question therefore is, How can the peril be averted ?

The topic of the control of the Indus has been touched upon earlier, when it was attempted to point out how necessary the proper control of that river is to the existence of Karachi Port, as well as for other reasons. It seems strange that, up to date, the question has attracted so little attention : the direction and management of the river is so all-important an undertaking that it appears almost incredible that no sustained efforts have, so far, been made to attempt the task. The irrigation works of Sind and the north-west are magnificent triumphs of water-engineering, but they have been carried out in such fashion as to be entirely dependent upon the river, in a state, more or less, of nature. It must at once be admitted that the feat of bridling the Indus is a task for Titans, should it be approached in the same way, for instance, as that of the management of the Nile. The very fact of the sources of the Indus being high up in the lofty Himalayas, imparting a speed and a strength to the current far greater than that of the Egyptian river, is one to be faced in all respects when approaching the matter of constructing engineering works in connection with it, and no such works partaking of the character of restrictants or checks--such as dams, weirs, etc.—have in the nature of things been attempted. But there are other ways in which the irrigation engineer can show his skill, and it may be said, without fear of contradiction, that the Public Works on the Indus are triumphs of engineering science unsurpassable anywhere. But engineering science has its limits, as has everything else, and the Indus still goes on its way free and unfettered and, consequently, as is so often the case, that way is very frequently a very mischievous one. To curb this wild untamed giant of nature, natural methods must be made use of—such as the planting of the banks to supplement the efforts of the engineer.

But, as has been pointed out, there are two causes at work in the choking up of Karachi Harbour : one is the Indus, the other is the desert which stretches along the littoral of the Mirpur Sakro Taluka from whence comes the sand which is not only blown over

Karachi but which comes in with the tide as well. Efforts have been made to deal with the latter cause. The Keamari Groyne was commenced in November 1861 and was completed to a length of about 7,000 feet in March 1863. Some 2,000 feet were added some years later and in 1873 the Manora Breakwater was finished. Besides these the Napier Mole has been opened and the China Creek has been closed. All these works have increased the "scour" and consequently have increased the volume of the material removed from the Harbour by their action; but none of these have done anything to alter the direction of the current, and so a great deal of the material moved by the scour is deposited on the beach at Clifton and at Ghigri, and some is borne away seawards. The unavoidable result is the increase of the sand dunes and "the probable creation of shoals outside the Harbour." The residue of the material remains permanently in the Harbour. Besides the ameliorative measures which have been mentioned, there are two sea-going dredgers at work and these minimise the accumulation amounting, it has been estimated, to 3¼ lakhs of tons annually, by between 60 and 70 per cent; that is, that at the least 20 per cent of the accumulation remains in the Harbour, or say 15,000 tons of detritus are added to the bed of the Harbour every year; but beyond this the construction of the Keamari Groyne has caused the breakwater on its eastern side to be silted up as is demonstrable by a comparison of the Harbour plans for 1858, 1890, 1898 and 1900. We should be well within the mark then if we take the annual increment of detritus in the Harbour to be 25,000 tons per annum—a startling statement if correct—but the plans of the Harbour appear to substantiate it.

It is therefore necessary, if it can be done, to stop the supply of sand which is coming persistently into the Harbour. The statement made above as to the probable creation of shoals outside the Port might safely be extended to the statement, the certain creation of shoals outside, for these conditions already exist in "*the shallow water and sand banks reaching a considerable distance seawards beyond the natural line of coast*"—conditions vouched for on the unimpeachable testimony of the Port Engineer, Mr.

Jackson. We need go no further afield to test the statement. It is possible to stop the supply of sand. We know where it comes from—from the littoral of Mirpur Sakro. Here there are miles upon miles of presently barren, unproductive sand, which are not only unproductive but a positive source of danger to the Port. These sands can be rendered innocuous and more, made profitable, by planting up. They can be treated differently from the banks of the Indus, that is, trees can be grown upon them straightway; the *Casuarina* grows splendidly in such positions, witness, amongst other experiments of the same nature, the *Casuarina* plantations at Alibag, Honavar, Karwar, and other places along the coast. The sandy expanse should be taken in hand and stocked with *Casuarina* and plants, such as the agave, varieties of hibiscus, oleanders, etc. As progress is made and the more valuable species find themselves and thrive, the less valuable ones may be discouraged. The great point just now is to get the sand under and to do this vegetation of almost any kind should be welcomed. The principal aim in view is the stoppage of the sand movement and the conserving of Karachi Harbour. In a very few years this same barren sketch of sand will become a fruitful source of revenue to its owners, be they Government, the Municipality or the Port Trust. It is a big question, it has a far-reaching aim, but the result is certain; and the gain to Karachi apart from that which forms the subject of this article will be enormous, if only taken in the light of a rich and conveniently handy wood reserve, not merely for fuel only, but for building and construction in many shapes and forms also.

THE AFFORESTATION OF THE LITTORAL OF MIRPUR SAKRO.

The problem of afforesting waste lands is one which is now attracting much attention, both on the Continent of Europe and in England: in the latter country, more, perhaps, from the point of view of affording employment to the thousands of unemployed than from the climatic or forest-quâ forest-standpoint. In Sind the latter is the outstanding reason, though the extension of forest or grazing lands would be most welcome to the large

pastoral population of Sind and Kohistan and would re-act most favourably on the criminal returns of the Province.

In the labour settlements of Holland, on either side of the railway which traverses Friedland, miles of barren sandy country in which, apparently, nothing could grow, have been recently planted with coniferous trees, which are evidently thriving and growing apace. The soil is very poor, dry and unwatered. Much of the least profitable soil at the voluntary colony of Frederiksvord has been devoted to afforestation and the heath country surrounding the State settlement of Veernlinzen is now thickly studded with pines. The same kind of thing is to be found at Merseplas in Belgium which is situated in the middle of a sandy plain. Reference has been made, a little way back, to the great success which has followed the efforts to consolidate the sand dunes in the Landes of Charente-Inferieure, Rè and Oléron in France: forty years ago, before their afforestation was taken in hand, these districts were considered to be the poorest in France; it is reckoned that they have now, since forests were introduced into them, added more than £40,000,000 to the wealth of the country. Expert opinion has it that had the forests of Ireland been conserved, instead of being permitted to be improved off the face of the earth, they would now represent a value which might well be stated at £100,000,000. In Scotland the timber resources of the country have also been ruthlessly trenched upon and their value enormously depreciated. The destruction of forests in the United Kingdom is a short-sighted policy to which the few are only now awakening, but the same thing is going on nearly everywhere; what specially concerns us is that it is going on in our own colonies. In India, of late years, the value of Forest Conservancy has been recognised and a wise and far-seeing care is being taken of present reserves and efforts are being made to improve and, where possible, to extend them. No better field for extension is possible than the sandy desert acres on the coast of Mirpur Sakro. It has been stated above that the danger they are to Karachi Harbour can be averted and that they can be rendered profitable and this statement is here reiterated. The question of

how to irrigate these miles of barren sand has been raised, and from the remarks made it is evidently considered that this is an impossible task. But this is by no means the case; the writer was in Sind for some years and during that period pondered the matter deeply and, as a result, made suggestions, which owing to various reasons chiefly, perhaps, fiscal ones, have never been taken up. In the first place the vegetation which should be encouraged at the commencement of the afforesting operations herein advocated, *i.e.*, Casuarina, tamarisks, agave and the like, does not need much water, and, secondly, it would thrive on *slightly brackish water: such water is obtainable in abundance a few feet below the surface*, and that surface being sand, the task of sinking wells would be a very light one. The second question is *the distribution of the water:* to do this it was proposed by the writer that when the wells—or rather *water-holes*, for they would need to be nothing more—had been sunk, the water should be raised by means of wind-mill pumps. The initial cost of such pumps is, comparatively speaking, very small, a pump costing between Rs. 600 and Rs. 800. These should be distributed throughout the area to be afforested, say, one to every ten square miles. They are portable and can be carried on camel-back and are easily and speedily erected *in situ* whenever and wherever required. The matter of irrigation being thus settled, the rest is merely a question of planting advisedly and conserving carefully; in ten years' time the lands would begin to pay; in thirty they would be yielding a high revenue. As vegetation prevails, soil is formed, the lands are consolidated, and then trees of the better and more paying species can be introduced. The whole operation is one well within the scope of ordinary practical forestry.

As in all *cultural* forest work, the initial cost will be heavy—though in the present case much lighter than is usual—and a number of years—ten at the least—must pass before any profit can be realised; but if the work is carried out scientifically and with due regard to its peculiar surroundings, it cannot fail to be a most profitable undertaking by whomsoever enterprised: if Government do not see their way to taking it up, it is well worth the attention, as stated above, of the Municipality or the Port Trust. The first

desideratum, and this would be attained very speedily, would be the stoppage of the sand movement which now prejudicially affects Karachi Harbour: the second, *i.e.*, a conveniently adjacent wood reserve for fuel and timber would be longer in coming, but its ultimate arrival is just as certain. The present policy of the Forest Department in Sind—I write under correction—and in the Presidency too, to a very great extent—is to ignore the production of timber of large scantling. In Sind the *coupes* are clean cut; no standards being reserved—the rotation being 30 years for *babul*, 15 years for *khandi*—the consequence is that all timber of large scantling will disappear, possibly has done so by this time. Sind babul is world-famous, and in past years the Dockyard and the Ordnance Department in Bombay used to employ it extensively, but they need timber of large scantling and the supply is being, it may be said has been, exhausted. At one time there were symptoms of a trade in timber from Sind to Mombassa, Zanzibar and the Persian Gulf, but the industry was strangled at its birth by the fact of the forests being unable to supply the class of timber wanted. Under the present régime, the Sind forests are being worked purely as fuel and fodder reserves, principally for the benefit of the North-Western Railway, and this too under the most cramping conditions, the contractors being bound to supply a stated amount of fuel at certain fixed rates, instead of being allowed to sell in the open market; this state of things may be changed now, but it obtained till a very recent date and has undoubtedly done much harm to the wood trade in Sind. The rate paid for fuel by the Railway was fixed, more or less arbitrarily, by the Railway authorities: it followed therefore that, in order to recoup themselves, the contractors charged higher prices than they would have otherwise done to the public, and trade in the chief centres, such as Karachi, Hyderabad, Sukkur, etc., suffered accordingly. The question is one of commercial interest: does it pay? or does it not? And on these lines it must be decided. In the writer's opinion standards should be retained to act as seed-bearers and nurses and to keep up the supply of large timber for the uses already mentioned, for buildings, etc.

The grazing question in Sind is a vitally important one: the *maldars*—as the graziers are called—reside and keep their flocks and herds—horned cattle, camels, sheep and goats—in Kohistan during the *abkalani*—or season of inundation of the Indus—but resort to the riverain forests in large numbers for the rest of the year. Many live in the forests in settlements specially marked out and reserved for the purpose. The rest squat outside, but all pasture their animals in the reserves. The *maldars* are, taken as a whole, a very quiet and docile people; of course, every now and again there is trouble with them, but, for the most part, they are tractable enough: still in one way they are a terror and real danger to the forests in which they roam, and that way is *fire*. The fires which so frequently occur are, it may safely be said, nine times out of ten, the work of the *maldars*, sometimes through accident, more often of set purpose and design: by firing the grass they consider that they improve and increase the prospects of pasturage for the next season and this is the reason for their acts of incendiarism. Could the grazing area, therefore, be extended and more ample grazing grounds be secured in this way, the great motive for setting the grass alight would be minimised and forest fires would then be events of less frequency than they are at present: it is obviously unnecessary to dwell on the benefits that would thus accrue to the young growth and forest conservancy generally: if the grazing area then could be enlarged in the way now suggested, another and most enormously important—though indirect—advantage to all the forests in the Province would be secured and, at the same time, revenue largely influenced for the better.

The subject is one of vast importance and affects the general weal of the public in all grades—from the highest to the lowest. The Continent of Europe, as in all matters appertaining to forestry and arboriculture in general, has led the way and given us an example of what can be done in the way of utilising what have been, up to the present, considered to be barren and unprofitable wastes. I see no reason why the wastes of India in general, and of Sind in particular, cannot be similarly treated: at any rate, there is little doubt that the wastes now under consideration can be afforested

and made both profitable and useful: that the Indus can be controlled in an appreciable degree and its banks saved from erosion to a considerabe extent, thus diminishing the amount of detritus brought down: that the sand showers can be stopped: and finally that Karachi Harbour can be kept open with far less labour in dredging and at much less expense than is now the case, and at the same time more effectually. The ideas here put forward are not impracticable chimeras, the suggestions made are all within the scope and grasp of practical application and can be worked out to a successful conclusion. If they are given effect to, I am confident that they will add considerably to the well-being of Karachi, the wealth of Sind and the prosperity of its people.

G. K. B.

[Owing to want of space we are precluded from printing the article on "Tree Influence on Rainfall" which appeared in the issue of the *Pioneer* of September 15th, 1906. This article the author gives as an Appendix to his interesting paper: It was fully commented upon in our leader in the September number of last year, Vol. XXXII, pp. 423—429.—HON. ED.]

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

HOLLAND AND HOLLAND'S NEW ·465 "VELOPEX" EXPRESS RIFLE.

Messrs. Holland and Holland have just introduced a series of rifles of calibres conforming with the requirements of the Indian Arms Act, in which a new bullet, designed by the firm, is employed. The object in view is to make the high velocity higher than before, the flat trajectory consequently flatter, and at the same time to keep the pressures at a level well within those limits of safety so necessary in a hot climate.

The new bullet is adapted for use in various cartridges, and two rifles, one of ·465 bore as a substitute for the ·450, the other a magazine rifle of ·375 bore, have been submitted for consideration. The bullet is of that essentially modern type in which the external dimensions approved by experience are adhered to, while the weight is reduced. The lead core is not continued up to the nose of the bullet, but the front third, or thereabouts, consists of some light material over which the nickel nose extends. The nose may be open for purposes of expansion or may be closed if preferred. The light material used, in the examples under consideration, is of wood, but other fibrous substances are employed and give equally good results. Bullets so constructed are named "Velopex," and their invariable characteristic is that, in relation to diameter and length, the weight is reduced. That is, in shape and appearance, the bullets conform to established conditions, but by the substitution of a lighter substance at the front of the core, their ballistic properties are materially improved.

Three weights of bullet have been designed for the ·465 cartridge. The heaviest is 480 grains, this being a projectile with full leaden core. Then comes a 365 grain bullet precisely the

same in dimensions, but of "Velopex" pattern with the wooden fronted core and finally there is another, lighter still for use on soft skinned animals. The cartridges are of the bottle-necked pattern, and resemble closely the well-known Holland 50·500-4 the case being modified for the ·465 bullet. The charge of cordite used is 75 grains, and with the two weights of projectile specified the ballistics compare thus :—

480 grain bullet 12·14 tons pressure, 2,141 f.s. muzzle velocity.
360 „ „ 10·71 „ „ 2,282 f.s. „ „

It is thus seen that the effect of lightening the projectile without altering its dimensions is very materially to reduce the chamber pressure for the same charge of powder and at the same time to increase the velocity to a marked extent. While these results are what might be expected in view of comparatively recent investigations concerning the effect of reducing the weight of bullets to obtain increased velocity and that flatness of trajectory so particularly valuable for sporting purposes, there is of course another essential point for consideration. To get this flat trajectory which nullifies misjudgments of distances within reasonable limits; this low chamber pressure which makes the rifle so suitable for use under fluctuating conditions of temperature; this high velocity with the advantage of low recoil; has anything been sacrificed in the way of accuracy? Will the ·465 bore shoot as well with the "Velopex" bullet as it does with the ordinary lead-cored nickel-coated projectile of normal weight?

The answer is that it will shoot better. Many diagrams have already been made and might be reproduced, but the group made when the rifle was shot in the presence of the Editor of the *Field* in London is so excellent that it is unlikely to be improved upon. The seven shots, fired at a range of 100 yards, grouped themselves so that they can be shown, six breaking one into the other, and the seventh just below the main group, all actually upon an ordinary postage stamp. This diagram was made at the first attempt, using open sights, and it constitutes a really remarkable indication of the wonderful accuracy of the Holland ·465 rifle in combination with the new "Velopex" bullet. The groups made with the rifle

and cartridge have been consistently good, but, having regard to human imperfections, it is not to be expected that the performance will be often repeated. To fully realise its merit a postage stamp on a target 100 yards away might be examined.

EXTRACTS FROM OFFICIAL PAPERS.

IMPROVEMENTS IN THE ADMINISTRATIVE POSTS OF THE IMPERIAL FOREST SERVICE.

Circular No. $\frac{5\ F.}{38-2.}$

GOVERNMENT OF INDIA.

DEPARTMENT OF REVENUE AND AGRICULTURE.

(FORESTS.)

Calcutta, the 15th February 1907.

RESOLUTION.

IN the Government of India Resolution No. 4 F., dated the 28th March 1906, it was stated that the Government of India had arrived at the conclusion that, in order to maintain the efficiency of the Imperial Branch of the Forest Service, it was necessary to take steps to improve the conditions of the service. The enhanced rates of pay of the administrative posts to which the sanction of the Secretary of State had been obtained were accordingly announced.

2. In order to complete the reorganisation of the Imperial Forest Service thus begun, the Government of India have now obtained the sanction of the Secretary of State to the following revision of the grading and emoluments of Deputy and Assistant Conservators of Forests.

It has been decided to abolish the present system of payment by grades and to establish in its place a system of personal pay

dependent on the length of service of the individual officer, according to the following scale :—

					Rs.	
In the	1st year of service		...	...	380	per mensem.
"	2nd	" "	... ...	...	420	"
"	3rd	" "	... ...	...	460	"
"	4th	" "	... ...	...	500	"
"	5th	" "	... ...	...	540	"
"	6th	" "	... ...	...	580	"
"	7th	" "	... ...	...	620	"
"	8th	" "	... ...	...	660	"
"	9th	" "	... ...	...	700	"
"	10th	" "	... ...	..	750	"
"	11th	" "	... ...	...	800	"
"	12th	" "	... ...	...	850	"
"	13th	" "	... ...	...	900	"
"	14th	" "	... ...	...	950	"
"	15th	" "	... ...	...	1,000	"
"	16th	" "	... ...	...	1,050	"
"	17th	" "	... ...	...	1,100	"
"	18th	" "	... ...	...	1,150	"
"	19th	" "	... ...	...	1,200	"
"	20th and following years of service			...	1,250	"

The above scale of pay will take the place of the existing grade pay, officiating allowances (below administrative rank) and exchange compensation allowance, but it will not affect existing special and local allowances such as those set forth in the Forest Department Code, and the corresponding allowances in Bombay and Madras. These allowances are granted to meet special conditions which remain unaltered.

3. (i) Whilst drawing pay up to and including Rs. 540 a month an officer will be styled "Assistant Conservator" and when drawing pay at Rs. 580 per mensem and upwards he will have the rank of a Deputy Conservator.

(ii) Until he has passed the examinations prescribed in Article 74, Forest Department Code, an Assistant Conservator may not draw pay at a higher rate than Rs. 460 a month. On passing the examinations he will resume

drawing pay under the time-scale at the rate to which his length of service entitles him.

(iii) Local Governments are authorized to stop the incremental rise of pay of any officer whose work in its opinion is not of a satisfactory nature.

(iv) As heretofore a Deputy Conservator officiating as a Conservator will be entitled to a salary equal to the pay of the lowest grade of Conservator.

4. The sanction of the Secretary of State has also been obtained to certain further improvements in respect to the administrative posts of the Imperial Forest Service, and the orders contained in Resolution No. 4 F., dated the 28th March 1906, are accordingly modified to the following extent:—

(i) A Conservator, officiating as Chief Conservator, or a Conservator or Chief Conservator, officiating as Inspector-General of Forests, will draw the full pay of the post.

(ii) The pay of the Inspector-General of Forests has been fixed at Rs. 2,650 a month.

5. The orders contained in this Resolution will have effect from the 6th January 1907, but should the time-scale of pay now sanctioned result in the diminution of the existing emoluments of any individual officer, he will retain his present salary until he becomes entitled to a higher rate under the time-scale.

ORDERED, that a copy of the above Resolution, together with a copy of the Despatches* to and from the Secretary of State, be forward, for information and guidance, to the Local Governments and Administrations noted in the margin, the Inspector-General of Forests, and the Comptroller, India Treasuries.

* To His Majesty's Secretary of State, No. 389, dated 1st November 1906.

From His Majesty's Secretary of State, No. 229 (Revenue), dated 21st December 1906.

Madras.	*Central Provinces.*
Bombay.	Coorg.
Bengal.	Ajmer.
United Provinces.	Baluchistan.
Punjab.	North-West Frontier Province.
Burma.	Superintendent, Port Blair.
Eastern Bengal and Assam.	

ORDERED also that a copy be forwarded to the Finance Department for information and further

action, with reference to its Resolution No. 210 Ex., dated the 11th January 1907, and that the Resolution be published in the Supplement to the *Gazette of India*.

E. D. MACLAGAN,
Officiating Secretary to the Government of India.

NOTE ON THE BANDA FORESTS.

(*Continued from page* 40.)

II.

The forests thus acquired were under the management of the Collector until 1891, when their management was transferred to the Forest Department and an Assistant Conservator appointed for the three ranges of Jhansi, Lalitpur and Banda, with headquarters at Jhansi.

The forests were the subject of a considerable amount of enquiry during the latter part of the time during which they were under the management of the Collector, as a result of which it was finally decided (Notification No. 791 F/34 of 15th February 1889) that the forests in which Government had acquired proprietary right should be declared "reserved forests" and a formal "settlement" made. This was finally carried out by Mr. Reynolds during 1890-91. As a result certain areas were demarcated from the tract of "reserved forest" and constituted into the "forest excluded areas." There were originally 13 of these areas—one in each of mauzas Rajauhan, Kulmar-Parasin, Donda (known as "Lakhanpur"), Amchurnarwa and Matdar; two in Deori (known as Deori and Jhil), two in Chaunri and four in Kulhua. In 1896, however the excluded areas in Donda (Lakhanpur) and Jhil of Deori having become totally uninhabited were declared to be "reserved forest". On the other hand, 716 acres in mauza Chulhi, though at the time of the forest settlement not declared to be a "forest excluded area," have subsequently (in 1901) been made one. There are thus now

12 separate areas in eight mauzas. These are known as the "forest villages."*

At the time of the transfer of the management of the forests to the Forest Department the management of these excluded areas was by mistake also transferred, and the mistake was not rectified until 1896, when they were re-transferred to the Collector's management under which they are still being treated precisely as any other Government estate, save that the income derived from them is credited to the Forest Department.

The inhabitants of these forest villages have certain rights of free grazing for a certain number of cattle and of free wood and grass for agricultural and domestic purposes, but not for sale. These are detailed in Notification No. 392F/34-109 of 11th May 1892.

The "reserved" and "pachpan-paintalis" forests are all, with the exception of the Kulhua forest, situated in the south and west of pargana Karwi. The Ranipur and Chauri-Donda forests form a strip along the extreme south of the pargana bordering on the States of Sohawal, Panna and Rewa. For the most part they consist of the northern slopes of the escarpment that bounds the Panna plateau, the district boundary as a rule running just at the top of the cliff (locally known as the "ari"). In places, however, as at Deori, Rajauhan, Mahuli and Kalyanpur the border runs on to the plateau and includes several square miles thereof. On the other hand, in the Dharkundi valley, south of Kalyanpur, the Panna border descends from the plateau and includes some of the low land. In addition to the slopes of the escarpment a not inconsiderable area of the low land is also included in the forest boundaries, and this forms the most valuable portion, as being both more accessible and possessing better soil.

The Manikpur and Tikariya forests are somewhat similarly situated relatively to the Kaimur escarpment. Beginning a little

* These areas do not include a small area in the reserved forest block of Matdar outside the "forest excluded area" known as Chak Matdar, which for some years past has been leased annually from cultivation by the Forest Department but which will probably be so leased no longer. This area is "reserved forest" and no rights of any kind exist over it or attach to the persons cultivating it.

way north-west of Manikpur they form a more or less continuous belt north of the East Indian line of rail to the district border. The escarpment here is lower, the valleys shallower, and the rock nearer the surface. Consequently there is less moisture and the forests are poorer. This is due to the formation of the country, as at this point the Kaimur scarp instead of, as has been the case from the Allahabad border to Manikpur, running down directly into the plain, is here separated by several miles of broken hilly country which occupies practically all the portion of the Karwi pargana west of the Manikpur-Karwi railway line. These hills are due to the outcrop of the Lower Vindhyan formation (Semri series).

The Matdar forest lies south of Karwi, and is very similar to the two just described. It is situated on a series of hills mainly of Lower Vindhyas formation.

The Kulhua forest, situated in the south-east corner of pargana Badausa contains some of the best forest in the district. It consists of a series of hills partaking of the characteristics of both types above described, but is more fortunate in possessing a much better water-supply, as a result of which the main Kulhua valley remains cool and green till well into the hot weather.

The forest throughout is of the normal Bundelkhand type, varying with the depth of soil. The only tree that really grows sufficiently to yield timber of any size is the mahua, but owing to the value of its flowers and fruit it is rarely cut. It seems possible that this fact may account for its growing sufficiently large to yield timber, and affords some support to the theory that closure and protection would enable other trees to do likewise. For the rest, the main sources of income are firewood, small timber (ballies, etc.), bamboos and minor forest produce, such as lac, tendu, chironji, ber, gum, honey, etc. A large amount of firewood and charcoal is despatched by rail to Allahabad and elsewhere.

(*To be continued.*)

MISCELLANEA.

THE CHIEF TIMBER TREES OF INDIA.

(Continued from page 107.)

BY J. NISBET, D. ŒC.

III.

The INDIAN JUNIPER, or HIMALAYAN PENCIL CEDAR (*Juniperus macropoda*), is one of the most important timber-trees in Baluchistan, whence it extends westwards into Afghanistan and eastwards to Nepal, growing at elevations varying from 5,000 to 14,000 feet. Its light, moderately hard and fragrant wood, red in colour and often with a purple tinge, though it has little strength, is used in these districts, where timber is at a premium, for all sorts of purposes, from building temples and forming beams and wall-plates to drinking cups and walking-sticks, while it is also used as fuel and burnt as incense. The bark at the base of old trees is of immense thickness, and is pulled off in long strips and used for roofing huts. This juniper forms pure forests at Ziarat in Baluchistan, and in the Pil and Zarghun ranges, while in the Hariáb district it forms fully half of the forest at 9,000 feet, and has *Pistacia*, a kind of ash, and the ebony prune as its chief associates. The finest tracts of juniper are those of the open forests of Ziarat, about 60 miles to the east of Quetta, the capital of Baluchistan, where they extend for over 200 square miles. The trees generally branch from the base, straight stems and clean boles being very rare. The lowest branches are often buried in leaf-mould and dead foliage, so that they have the appearance of younger growth rising up round a parent stem. The rate of growth is slow, though the trees occasionally rise to a height of 70 feet and attain a girth of 20 feet. Alhough it reproduces itself naturally from seed, it often happens that very few of the seedlings survive, owing to fire. Throughout these juniper

tracts the hill-sides still show remains of old stems killed through fires lit against them by shepherds at night, in order to scare wild beasts from the flocks,—a practice that is now, fortunately, almost extinct. Happily, too, most of such dead trees are surrounded by a younger generation of saplings, poles and young trees growing vigorously without much shelter. The principle agent in sowing the seed is a bird called the "Obisht-khwarak," or juniper-eater. Though slow, the reproduction of these forests is now ensured, and the fears once entertained as to maintaining the supply of wood for future use are now at an end. In its Himalayan habitat the juniper is usually found growing gregariously on rocky slopes, where it does not generally grow over about 50 feet in height, though its girth is often considerable, 6 to 7 feet being not uncommon. Exceptional girths of 20 feet and more are sometimes reached, the largest being 33½ feet at Lahoul.

The KHAIR, or CUTCH-TREE (*Acacia Catechu*), is a tree of exceptional value, not only on account of its very hard, heavy, and durable wood, varying from dark red-brown to light brick-red in colour, but also, and more particuarly, from the brown-black astringent product, the "cutch" of commerce, obtained from boiling chips of the heartwood, and known as *kath* in Northern India and *sha* in Burma, the preservative dye used to produce the dark-brown colour of sail-cloths, fishing-nets, etc. The wood is a splendid timber, which takes a fine polish and is extremely durable, defying both white-ants and the teredo. The only reason of its not being very extensively used as timber is the unfortunate fact that it does not grow to large demensions. The cutch tree is common in the lower deciduous forests of most parts of India and Burma where the rainfall is moderate. In Burma its distribution extends very little above the tropic line, but in Upper India it spreads to the sub-Himalayan tracts west of the Indus, and there ascends the valleys to a height of about 3,000 feet. There are three distinct varieties of this tree in which the calyx, petals, and rachis of the leaves are respectively hairy, downy and smooth. The hairy variety is that common to the dry regions of Upper and Central India, but rare in Burma: the downy kind is that found

chiefly in the much moister locality of Bengal, Sikkim, Assam, and Burma; while the smooth variety is confined to the arid regions of the Deccan, Carnatic, Rajputana, Western India, and the dry zones of Upper Burma. In India, the khair or light red variety is found both sporadically and also more or less gregariously, interspersed among the other deciduous trees characteristic of the dry forests. When gregarious, it is usually found—like the Sissoo, though seldom growing along with it—on newly raised banks in beds of streams issuing from the mountain ranges down which the seed pods are borne by the waters, and get lodged among the sand and boulders of the freshly deposited banks and islands. Such river-bed *khair* forests seldom show any natural regeneration, as they are liable to be washed away by floods, consequently the trees can be freely felled, whenever of marketable dimensions, for *kath*-boiling. The new growths springing up spontaneously on fresh silt-deposits require no treatment except protection against grazing, as they soon thin themselves sufficiently, and need to be kept fairly dense in order to prevent erosion of the soil. In Burma the growth of the *sha* tree, yielding the dark coloured wood, is more usually sporadic than gregarious, though in some of the forests of the Prome and Thayetmyo districts, and in the southern part of Upper Burma, in the zone having an average rainfall of from about 40 or 45 to 55 or 60 inches a year, it forms a considerable proportion of the trees found in certain localities. In these districts cutch-boiling forms an important rural industry, and in years of scanty rainfall additional facilities are offered for this in order to reduce the pressure upon the poorer agricultural population. So far as cutch-boiling is concerned, *sha* trees are marketable as soon as they are a foot in diameter, but felling is usually limited to trees of 4½ feet in girth at 6 feet above the ground, in order to ensure proper regeneration and the maintenance of future supplies. To regulate the manufacture of cutch, many of the best tracts have been reserved, and are worked by area, like coppices in Britain, with a rotation of about 30 years. In such reserves the right of making the fall of timber in the precise locality permitted by the working-plan is sold by auction each year, and the blanks thus

formed are sown with seed; but outside these reserves the neighbouring villagers are permitted to fell and boil, after taking out licenses for a specific number of trees. Seed-production is abundant, and natural regeneration is prolific, while the tree coppices freely. But, in addition to relying on spontaneous growth, much is also done in the way of sowings to increase supplies in the drier forests where the growth of teak is less vigorous than that of cutch, as is particulary the case in the drier forests where the timber-trees are chiefly associated with small kinds of bamboos.

(To be continued.)

FIG. 2. NORTHERN INDIA 'BARA-SINGH'.

Photo.-Mechl. Dept., Thomason College, Roorkee. Photo. by S. Eardley-Wilmot.

FIG. 1. TYPICAL ANTLER OF A NORTHERN INDIA 'BARA-SINGH' (SWAMP DEER).

VOLUME XXXIII NUMBER 4

INDIAN FORESTER

APRIL, 1907.

FORESTRY TUITION IN SCHOOLS AND UNIVERSITIES.

We have taken the subject of Forestry tuition as our text on several occasions during the last few years and our remarks have given rise on various occasions to some most useful and apt criticism from those whose opinions were a valuable asset in the discussion. It will be obvious to all that criticism without adequate and personal knowledge of the subject treated of, a knowledge which can only result from long and careful study of all sides of the question under consideration, is not only worthless but is to be strongly deprecated as likely to have adverse consequences and lead to the very evils which it was hoped to prevent.

In previous articles we have dealt with the subject of Forestry tuition at Cooper's Hill and at Oxford and have compared the latter with that given at Dehra Dun, which was at the time a School and not a College; this latter difference is an important one. We wish here to briefly consider the different nature of the tuition which is given in a College as opposed to a School. The occasion is an opportune one since the old English Forestry Schools at Coopers Hill and Dehra Dun have passed away and

the Forest probationers now receive their education at institutions having the status of Colleges.

The methods by which education is imparted in a School are well known. The hours of attendance for instruction are fixed and must be rigidly adhered to. The instruction is given in the form of "lessons": certain fixed portions of the subject have to be committed to memory, other portions have to be translated, exercises have to be written, etc. *The main idea underlying the* method of instruction is to improve and strengthen the powers of *memory* whilst imparting information necessary to the student for his after-battle in the world. It will be noted that whilst the mind is filled with various forms of knowledge, often assimilated more or less parrot-like by the student, and much of which will be quickly forgotten as soon as he leaves School, the method of tuition has no stimulating effect on improving the powers of *observation* or in leading the student to make deductions and observations and to reason out things for himself. In fact School education has usually just the opposite effect—it results in a mass of information being assimilated, perhaps sufficiently to enable the pupil to pass a difficult examination with credit, whilst the faculty of observing for himself, should he naturally possess any, has been left entirely untrained and often leaves him, unless he *endeavours to educate it himself, eminently* unpractical for the rest of his life, in spite of his scholastic honours.

In what respects then does a College education differ from the one we have sketched above? The whole aim of such an education is, or should be, to train the powers of observation in such a manner as to lead the student to naturally enquire into and reason out things for himself. There should be no compulsion in such a training for no good original work ever came from a compulsory system of tuition. In our College we would lay down the various courses to be followed by the student during the period of probation leading up to the examination for the diploma or other degree which he wishes to take. We would choose the best staff available to deliver these courses and arrange for a tutorial supervision over the students. But that is all. Men at a

College should not be treated as school boys or no good will result from the education imparted. Take, *e.g.*, the special case of the man working for a diploma of Forestry. The Forester cannot be made by compulsion, and if his heart is not in the work, which will certainly be the case if his powers of observation are limited to the extent so often found in India, it is merely wasting valuable time to endeavour to fill his mind with knowledge on School lines, knowledge which even should it enable him to obtain a diploma will be forgotten before he has completed a year of service. The reason why after a certain age a boy should leave a School for a College is that only on reaching an institution of the latter kind will he have his chance of putting into practice, under suitable supervision, knowledge he has assimilated ; of pursuing under expert direction, any particular branch of work in which he may be or may become specially interested. And, to glance at the other side of the picture, it is only when men are working at a College that their individual idiosyncrasies come out and can be ascertained by their tutors. Their attendances at lectures, for there is no actual compulsion in the matter and should be none, are noted by these latter, and the student who does not attend regularly is warned, and, if necessary, as would be the case of a subsidised student working at a special course to obtain a diploma, sent down. Each student's career during his diploma course is carefully watched, and this work does not fall on the shoulders of the tutor alone, for it may be taken as certain that each expert delivering a course of lectures in his speciality will carefully and closely watch the men he is lecturing to with a view to noting any one of them who is likely to make a special study of his own branch. It is perhaps unnecessary to state that every expert is only too eager to get workers in his own line and to give every facility and encouragement to a promising student without counting the cost of the extra labour it means to himself. In this we are only stating a truism known to every specialist.

We see then that during the period of training to be undergone to obtain his diploma or degree the student, whilst his attendance at lectures is left more or less to his own initiative

would not, in cases where he was stipendary or where an appointment in the department which was educating him was dependent upon his obtaining his diploma, be allowed to remain at the College unless he attended the courses of instruction laid down. In a College whose work was solely guided towards training men for a particular department this matter of attendance at lectures would be a simple one, but it should not be made on School lines with attendance registers, roll calls, etc.

As to the lectures. The first essential is that they should be given by experts and that suitable text-books dealing with the subject should be available. The second that they should be illustrated by as much practical work as possible, all tending to increase the powers of observation of the student and to naturally direct them into the channels required.

So much for the diploma course. This ordinarily will be the end of the student's career at the College, but for our experts it is only the beginning of things should they have been able to mark down a particularly brilliant man in their own branch. In such cases should the student be willing, and there be no objection on the part of the authorities, the expert will wish to keep him on for a further period to give him a special course of work, mostly practical in all probability, with a few lectures only; this course will be given under his direct supervision and during the period the student will be encouraged to carry out original investigation work on his own account. To take the special case of a student who has done brilliantly in a Forestry diploma course. It may be desirable that he should go through a special extra course in some particular branch of work. The value of such a course given to suitable men is absolutely incalculable in its after good effects and is one of *the* justifications for the entertainment at a College of a staff of experts in their own subjects. The professional work of these latter is of direct economic benefit to the Government of the day, but their special educational work will not only produce the men who are one day to fill their places but will also result in sending out men qualified to work in the field or supervise work of a special nature in different parts of the country.

A diploma or ordinary degree once obtained hall marks the man as being competent to carry out certain professional work for which he has followed the prescribed course. Extra courses beyond this degree or diploma should usually only be granted where marked ability has been exhibited, and should only be permitted in the one direction in which the student has shown special aptitude. Further work or research in other directions is merely to belittle the diploma, proving that the courses given for it are not of sufficiently high a standard. The diploma once gained a student pursuing a further course should be left under the personal supervision and direction of the expert under whom the further course is being carried out. The latter should be responsible for him, and the further certificates gained by the student will be signed by the expert, for his signature alone would be accepted by the professional man who wishes to make use of the former's services or by the scientific world as proof of their holder's attainments.

To turn to our special case of the Forest Department in India. We think the question of opening these special courses to men of marked merit is one which requires the gravest consideration. Reflection will, we feel convinced, leave little doubt that the reluctance exhibited in the past to permit men who had particularly distinguished themselves in some branch of forest science to follow extra courses in that subject has been a serious and direct loss to the Department, both in the direction of the improvement of the revenue of the Forest Estate in India and in the much needed direction of research work. We are here however only concerned with the future and we think that it is of the utmost importance that the question of extra courses to be given to students should only be considered on the understanding that they are not to be supplementary to the whole of the diploma course. Such a policy would be fatal to both. A man can only specialise, to be of any use, in one subject and any extra training given to selected men should be in that one subject. If a higher training is required in other branches the standard for the diploma should be raised. First make your probationer a Forest Officer

of the standard required and then, should it be necessary, give him the extra training to make him a specialist. For instance, should it be deemed necessary that a man who has done well in his diploma course should be given extra training in working-plans, engineering or surveying, all subjects which will bear specialism in India, let the extra course be confined to *one* of these subjects and do not aim at giving him a higher smattering in all. To attempt the latter would be merely to waste the time of the educational experts without turning out the product required.

SCIENTIFIC PAPERS.

LECANIUM CAPREÆ, LINN., AS A PEST TO ALMOND TREES IN BALUCHISTAN.

BY E. P. STEBBING.

Whilst on tour in Baluchistan in the spring of 1905 my attention was drawn to the serious manner in which almond trees in the fruit gardens of the country were infested by a scale insect. In the Gulistan Garden in Peshin I was told that the insect was so plentiful that it often completely covered the branches of the trees, causing them to dry up owing to the excessive tapping of the sap they underwent. Subsequent inspection satisfied me that the pest was also present in Fort Sandeman and the Zhob District and it is probably distributed throughout Baluchistan.

From such examination of the scale as I was able to make I was unable to identify it with any of the commoner Indian forms, and I accordingly despatched examples to my friend Mr. E. Ernest Green, Government Entomologist, Ceylon. His reply is of considerable interest.

"Your Coccid on almond trees proves to be *Lecanium capreæ* not previously recorded from the Indian Region."

"Newstead, in his monograph of British *Coccidæ*, says that this species is sometimes extremely abundant in scattered hedges of hawthorn and that it sometimes kills large patches of the hedges."

The point of considerable scientific importance is the fact that this is the first report of the occurrence of the insect in the Indian Region and this in spite of its widespread abundance in Peshin and elsewhere in Baluchistan. It will be remembered by those interested in the distribution of insects, and more especially in the distribution of insect pests, that the well-known borer of the poplar and willow trees in Quetta (Aeolesthes sartus)* popularly known as the "Quetta Borer" proved to be a species unknown to the Indian Region and only previously recorded from Central Turkestan.

The fact of finding insects acting the part of serious pests in such a comparatively new country, from an economic agricultural point of view, as Baluchistan opens up the interesting question as to their present distribution and former origin. Are these and other at present undetermined but plentiful species such as, *e.g.*, the ***Pemphigus sp.*** which form galls on the poplars of this region; the Aphids on the almond, peach; *Batocera rubus* in the fig trees, etc., present in Afghanistan to the north and throughout Persia to the west and are they spreading from the northward and westwards or from the former area only?

Lecanium capreæ first makes its appearance in the form of white sticky masses on the trees in Peshin about the middle of April. After about a week small yellow scales begin to form on the outer bark of the branches and exudations commence. The scales turn black in from 40—45 days and from beneath the black shrivelled scale small yellow larvæ begin to appear. The black scales are said to remain on the tree for from 3—4 months and then drop off.

The scale is said to have been first noticed in 1902, only a few trees being attacked. The scale rapidly spread about 90 per cent of the trees in Gulistan being attacked in 1904 and 50 per cent in 1905. The scale is said to either kill the tree outright or to only badly infest and kill off some of the branches. The only remedy that has been tried is to cut off and burn the worst infested branches.

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* *Vide* my monograph "A Note on the Quetta Borer," Superintendent, Government of India Press, Calcutta (1905).

To clear the trees of a pest of this nature the Resin Compound would probably be effective. It is made as follows:—Powder together 8 lbs. of resin and 4 lbs. of washing soda. Mix and boil in one gallon of water. When dissolved continue to add water slowly till the total amount has reached about 5 gallons, boiling continuously; continue the boiling till the mixture becomes clear and thin. Dilute one part with 9 of water and make up 50 gallons. The solution should then be sprayed on the branches with a sprayer.

ORIGINAL ARTICLES

ORIGINAL ARTICLES.

THE REPRODUCTION OF SAL FROM SEED.

BY W. H. LOVEGROVE, I.F.S.

THE SEED, ITS GERMINATION AND FIRST GROWTH.

The sal in common with most other species produces the best seed from trees that have just reached their maximum height growth. The seed itself is heavy and winged: the wings allowing it to fall lightly on the ground and with the help of the wind at some distance from the parent tree.

The seeds fall in the latter part of the hot weather, in May, June, or July: it should be noted that at this season the forest undergrowth is at its least shade density.

2. Favoured by a hot weather shower the seed germinates by the usual process, first sending down the radicle followed shortly by the upward growth of the plumule. Germination taking place as it does generally before the burst of the monsoon, it is obvious that the sooner the radicle reaches a proper condition of soil the better. The first growth is nourished by the food material stored in the seed itself, but, on account of the rapidity of growth its period of independence is not very long: hence so soon as this natural store has been absorbed the seedling is dependant on outside sources for its food.

3. During the following rains the seedling is employed in forcing its roots well down into the soil, the plumule being less

vigorous in its development. This is a very necessary provision of nature against the coming winter and hot weather, for the shoots above ground are almost invariably killed off during the first few years by frost, fire, or drought. The stock however continues to throw out new shoots every growing season until the rootlets strike a more fertile layer of soil, or a favourable season intervenes (probably a combination of both) when by the extra vigour imparted to its whole system, it produces a strong shoot clothed in a thicker bark which affords protection against its enemies. Nature's aim is the production at first of a strong and extensive root system.

SAL, A LIGHT DEMANDER.

4. It has often been stated that sal is a shade bearer at least until its pole stage. This is not altogether correct. In this connection it should be borne in mind that the sal's growing season begins in April, at a time when the undergrowth is at its least shade density.

From what has been stated under the previous heading it will be gathered that in its initial growth protection against frost and drought by means of shade is required. That is true, but so soon as it has established itself, and thence forward, the sal is a light demander.

5. In considering the above one must not overlook the accommodating nature of the sal, a fact due to its elaborate root system, and apparent when one takes into consideration the variety of localities in which the tree is found. The writer has seen it in the form of a forest at 5,000 feet elevation, where frosts were regular and snow not uncommon : he has seen it in frost localities where the tree was merely a tall pillar of epicormic branches on a knotty stem : he has seen it in the moist tropical climate at the foot of the Himalayas in Bengal where frosts are extremely rare and he has seen it in the hot dry climate of Chota Nagpur in the centre of India where frost is unknown and where the temperature rises to 117° Fahrenheit in the shade. With such a large range the accommodating nature of the sal is obvious and wherever it grows its light demanding character is noticeable : that it will stand, *within limits*,

a certain amount of shade until its head has reached a height to ensure its preservation from its greatest enemy, frost, instances its accommodating nature.

THE SOIL.

6. Sal reproduction is best on a moderately light, deep, well-drained mineral soil. Too much humus is not advantageous, but the presence of a sufficient quantity of soluble phosphates seems a necessity.

Being a moderately deep-rooted tree and one that starts growing early in the season, the sal naturally demands a light deep soil.

The reason for a well-drained condition is not quite so apparent: it seems however due to the requirement of air by the roots. The roots of all species require, in different degrees, a certain amount of air; the sal appears to be one of those requiring a considerable amount which it obtains from the soil, or from water percolating through the soil: stagnant water holds little or no air.

The reasons sal requires (as do the majority of species) to come in contact with mineral soil as soon as possible after germination are both physical and chemical.

The physical reasons are (1) in a proper condition mineral soil holds moisture longer than—for example—a bed of humus; and (2) in consequence thereof the radicle is less likely to dry up during the dry spells between the hot weather showers.

The chemical reason being that the food materials stored in the seed itself are more of an organic than an inorganic nature, the seedling therefore requires to come in contact with mineral soil as soon as possible in order that it may absorb into its system the *inorganic food, i.e.*, soluble nitrates, phosphates, etc., so necessary to its growth *and found only in mineral soils.*

That seed will germinate without humus can be seen on any recently disturbed earth in a sal forest—such as when a road has been recently made. On the other hand, however, in a forest humus, with its physical and chemical properties, takes the place of hoeing, ploughing, etc., in cultivation, in that it puts the top

soil in a proper state of tilth which is of immense advantage to the *after* growth of the tree, however much the humus may have been in the way at first.

The statement that a fair proportion of soluble phosphates in the soil is necessary to a proper germination is based on some experiments carried out by the writer some years ago. He noticed that land physically and geologically similar to all appearances bore different proportions of sal reproduction, notwithstanding the presence of sufficient mother trees. After some preliminaries he selected three typical areas in close proximity on all of which there was no apparent reason why sal seedlings should not be profuse. Samples of earth were carefully taken from each and analysed by Dr. Leather—with the result that (1) where reproduction was best the soil contained the most soluble phosphates; (2) where medium, a lesser quantity; (3) and where *nil* the least.

This was of course most important and interesting though, as to the preference shown by a species to a particular salt, not surprising.

The above experiment refers to one district. It is suggested that other experiments might be carried out to prove whether the conclusions here drawn are of general application or not.

7. Before closing this note it may be useful if the conclusions derived from the above are applied to certain questions now troubling Forest Officers.

One of the first of these is why fire conservancy in the poorly drained, moist, tropical areas at the foot of the hills in Bengal and Assam has had the opposite to a good effect on sal reproduction; whereas the same in the better drained and drier climate of the United Provinces and Chota Nagpur, etc., in Western Bengal has been followed by a splendid reproduction. It seems evident that fire conservancy in the flat, moist, tropical areas has encouraged an excess of inferior species and weeds, which have not only been the cause of a thick layer of humus, but, principally, by their heavy shade, have prevented the sal seedling from getting the light it so much demands: also in consequence of the resultant loosening of the top soil on very flat ground it probably has caused the stagnation

of water to a greater degree than was previously the case. The remedy must therefore be the elimination of the inferior species and weeds, and, if necessary, drainage.

On the other hand in the *undulating* drier climates where profuse reproduction has followed fire conservancy the reason is not far to seek.

In these situations inferior species and weeds are not so numerous or pushing, and the little present were annually burnt down. The advent of fire conservancy supplied just that quantity of shade protection needed, it lessened the number of sal shoots annually killed off and, by bringing the surface of the soil into a *softer condition*, allowed more seedlings to establish themselves.

Another vexed question is why in sal forests there are certain blanks which refuse to clothe themselves, whilst near by—even on a fire line—reproduction is profuse. This may be due to either—

(1) Lack of sufficiently old mother trees.

(2) Want of drainage.

(3) Paucity of soluble phosphates in the soil.

NAINI TAL:
24th February 1907.

NOTE ON SAL REPRODUCTION.

BY E. M. COVENTRY, I.F.S.

Having held charge of Kalesar sal forest (Simla Division) which is situated near the western limit of this species and being now in charge of the Darrang and Nowgong districts of Assam where sal reaches its eastern limit, it is curious to notice how its requirements differ in accordance with the differences of climate.

At Kalesar it is very cold in winter and there is often frost at night in low-lying places, whilst in summer it is very hot and dry. There is generally some rain about Christmas and some showers in the spring, but the monsoon does not set in till the end of June and the rains are practically over by the beginning of September. The rainfall is 30 to 40 inches so far as I remember or perhaps less. In Assam there are no frosts at night, but in December and

January fogs are of daily occurrence in Nowgong and often last until 9 or 10 A.M. From November to the end of February it is fairly dry, there being only about 2 inches of rain during this period. in March the temperature begins to rise, but heavy showers fall in April which reduce it considerably. Between May and the end of September the rainfall is fairly heavy, and the air becomes saturated with moisture. The rainfall of Nowgong is 77 inches and of Balipara in Darrang 90 inches.

Thus in the west there is a dry climate with great extremes of temperature, whilst in the east there is a damp climate without these great extremes, the temperature varying from an average minimum of 51° in January to an average maximum of 89·8° in July and seldom much exceeding 90°.

Sal seedlings are killed by frost or long-continued drought. Consequently in the west a certain amount of cover is necessary. In Assam, on the contrary, frosts and long-continued droughts are not to be feared, and cover seems to be the last thing the seedlings require. It is not meant, of course, that they grow best on absolutely bare ground. They probably require side shelter, *e.g.*, that provided by long grass when they grow very well, but any cover overhead seems most injurious. Owing to the damp climate the sal forests generally contain a dense undergrowth of small trees, shrubs and often climbers. Sal seedlings spring up but do not persist for many years unless uncovered. I have lately been inspecting a forest where, according to the *Forest Journal*, there was excellent reproduction 20 years ago. At present seedlings are very scarce and there is little sign of those of 20 years ago. Here and there a small sapling is met with, but crooked, dead at the top, owing to the cover overhead, and quite useless. In fact young growth of the past 20 years is almost entirely absent where there has been cover overhead.

Before forest conservancy commenced, the forests were probably burnt annually. (The old reports state that the forests had been ruined by the annual fires.) This probably destroyed most of the undergrowth and kept the cover fairly open, thus allowing the seedlings to grow up. (Excellent reproduction can be seen in

grass lands which are burnt every year, though the fires must do considerable damage to the young trees.) Since the introduction of fire conservancy, a dense undergrowth has sprung up through which the sal seedlings are unable to force their way and sooner or later they are smothered and killed.

The question of the reproduction of the sal forests of Assam is thus a difficult one. The only thing to do appears to be to cut back the undergrowth as soon as seedlings make their appearance. The undergrowth will spring up again, so that this operation will require repetition yearly or at intervals of two or more years until the seedlings are no longer liable to be suppressed by it. But even when they are out of danger from the undergrowth, the saplings are liable to be killed by the cover overhead unless it is very open. Consequently, when they are well established and say about 10 feet high, all the trees standing above them should be felled. The cover should not be removed until the saplings are well established otherwise a dense mass of herbaceous growth and climbers will spring up which will make reproduction almost impossible.

Since therefore sal is liable to be suppressed and killed in the seedling stage by the undergrowth and in the sapling stage by the cover overhead, it appears that the selection system is unsuited to the sal forests of Assam. What is required would seem to be to grow sal as an even-aged crop, and since the reproduction will generally occur in irregular patches scattered throughout the forests, the "shelterwood group system" of Dr. Schlich's "Manual of Forestry," Vol. I, would appear to be the most suitable system. But the forests contain at present large numbers of crooked and unsound trees, so that they require to be worked through first with a series of "restoration" fellings.

I should be much obliged for any criticisms on the above. At any rate there is no doubt that the matter requiring most attention in the Assam sal forests is the reproduction.

TEZPUR:
January 14th, 1907

NOTES ON EXPERIMENTAL PLANTATION OF HARDWICKIA BINATA, MELIA AZADIRACHTA AND ALBIZZIA LEBBEK, WHICH WERE COMMENCED IN THE RAINS OF 1905.

BY L. S. OSMASTON, I.F.S.

I.—Description of locality in which plantations were made.

(*a*) *Position.*—Forest of Satpur village of the Nasik Range of the Nasik Division, 3½ miles west of Nasik City.

(*b*) *Rainfall.*—Average annual rainfall about 24 inches, the whole rainfall practically falling between June 1st and November 1st.

(*c*) *Elevation above sea-level* 2,000 *ft.*

(*d*) *Aspect.*—North to west; ground gently sloping.

(*e*) *Soil*—6″ to 2′ of reddish brown soil formed from Deccan trap: here and there a little black alluvial soil: below this hard shaly muram or shaly partly disintegrated trap rock. Humus *nil*.

Existing growth.—Almost bare of tree growth: a few specimens of Butea frondosa, Acacia leucophlœa and Acacia arabica here and there in the forest, but none at the spot where the experiments were actually made, and the tree cover is therefore *nil*: the forest has been well closed to cattle grazing for four years and the prevailing grass grows to an average height annually of 12′; tufts of grass of a taller growing species than the prevailing are found scattered throughout at about 12′ between the clumps and attaining a height of 3′ to 4′. No forest fire has occurred in the last three years, and although the grass is sold for cutting and removal, much of it remains uncut and dies down annually.

II.—Nature of plantations made and their results noted after one year from planting or sowing as the case may be.

The plantations were made in June 1905.

PLANTATION KIND No. I.

Description.

Broadcasting without any previous preparation of the soil, average distance between the broadcasted seed being about 2½′.

Results.

Albizzia lebbek.—Seedlings which came up in the rains of 1905 have died: seed which failed to germinate in 1905 germinated in the rains of 1906, and in July 1906 I counted 155 such seedlings over $\frac{1}{20}$th of an acre, or 3,100 per acre; whether these will die in the coming hot weather remains to be seen.

Hardwickia binata.—Seedlings came up in the rains of 1905, of which plants at the rate of 1,037 per acre survived the 12 months, look quite healthy, and may be said to have established themselves. No seeds germinated in 1906.

PLANTATION KIND NO II.

Description.

Dibbling: holes an inch or so deep were made about 8′ apart, the seed was then put in them and the soil removed from the hole was then replaced over the seed.

Results.

Albizzia lebbek.—Seedlings which came up in the rains of 1905 have all died: seed which failed to germinate in 1905 did so in the rains of 1906 at the rate of 1,612 dibbles per acre; it is to be seen whether they will survive the hot weather.

Hardwickia binata.—No seedlings survived the hot weather, the result is therefore a total failure.

PLANTATION KIND NO. III.

Description.

Sowing seed on circular mounds—

(*a*) Large mounds $2\frac{1}{4}$′ high, 2′ diameter at top and 7′ diameter at base.

(*b*) Medium mounds 12″ to 15″ high, 2′ diameter at top and 4′ diameter at base.

(*c*) Mounds 9″ high and 3′ broad at base.

Note.—These dimensions were taken when the mounds had settled down and one year after making. One man can make in one day 5 to 7 large mounds or 12 to 18 medium mounds or 25 to 35 small mounds, according as the mounds are made in the rains or in the hot weather. The average cost per acre at 1,000 mounds an acre, the rate of wage per day being 3 annas, would be Rs. 31, Rs. $12\frac{1}{2}$ and Rs. 6 respectively. The tops of the mounds should be weeded once during each of the first two rains, but this will cost very little. When making the mounds the surface of the ground on which the mounds will be should first be broken up to a depth of a few inches. If possible soil from below the grass root layer should be used for making the mound as otherwise grass and weed roots and seeds will be in the mound and will produce a thick crop of grass and weeds. If possible the soil of the mound should be exposed to the air for some months (a year if practicable) before sowing. The soil of the mounds should be made small and should not be left in clods.

Results.

The number and percentage of mounds which proved successful are as follows :—

Kind of seed.	SUCCESSES.					
	(*a*) LARGE MOUNDS.		(*b*) MEDIUM MOUNDS.		(*c*) SMALL MOUNDS.	
	No.	Per cent.	No.	Per cent.	No.	Per cent.
Albizzia lebbek and seed of another tree not yet known.	a. b. 32+2 out of 34 sown.	100	a. b. c 52+31+10 out of 104 sown.	89·4	a. b. c. 11+2+8 out of 21 sown.	100
Hardwickia binata ...	61 out of 68 sown	89·7	80 out of 141 sown.	56·7	None sown.	
Melia azadirachta ...	10 out of 20 sown.	50·0	6 out of 39 sown.	15	"	

Notes.—

(*a*) Denotes mounds in which 1905 seedlings of Albizzia lebbek have established themselves.

(*b*) Denotes mounds in which 1905 seedlings of the unknown tree only have established themselves.

(*c*) Denotes mounds in which 1905 seedlings of Albizzia lebbek did not establish themselves, but in which seeds of this tree have germinated in the rains of 1906.

Unfortunately some unknown seed got mixed with the Albizzia lebbek seed before sowing; from the appearance of the seedling from this unknown seed I think it will turn out to be Albizzia odoratissima or Albizzia procera.

The large percentage of failures of Melia azadirachta is due to the badness of the seed, most of which I know to have been collected before it was ripe; from the look of the plants which have come up I feel sure that if the seed had been as good as that of Albizzia lebbek the proportion of successes would have been as many as in the case of this last-named species.

Sixteen months after sowing, one of the seedlings of Melia azadirachta on the big mounds was 3′ high and one of Albizzia lebbek 2′ high.

PLANTATION KIND No. IV.

Description.

Sowing in 12″ deep and 12″ diameter.

(*a*) All the excavated soil was returned into the pit and the seed was sown on the top of the refilled pit.

(*b*) Half the excavated soil was returned into the pit and the seed thus sown some 6″ below the general ground level.

Note.—One man can in one day make from 40 to 60 such pits according to the season. The average cost per acre at 1,000 pits per acre and 3 annas a day wage would be Rs. 4.

Results.

The successes per 100 pits are as follows :—

Kind of seed.	(*a*) All soil returned to pit.		(*b*) Pits half refilled with soil.		(*c*) No soil returned to pit.	
	No.	Per cent.	No.	Per cent.	No.	Per cent.
Albizzia lebbek ...	6 out of 16 sown.	37	11 out of 16	68	7 out of 16	43
Hardwickia binata ...	1 out of 16 sown.	6	6 out of 16	37	6 out of 16	37
Melia azadirachta ...	0 out of 16 sown.	0	0 out of 16	0	0 out of 16	0

Note.—The seeds of Melia azadirachta were too bad for any inference to be drawn from this experiment in respect of this species.

Plantation Kind No. V.

Description.

Broadcast sowing after once simple ploughing without harrowing or removal of tufts of grass ploughed up. No subsequent weeding. Only Hardwickia binata was experimented with and it was very thickly sown.

Results.

The number of plants which had established themselves over the area so treated (a patch 154′ × 6′) was 70, which works out to 6,600 per acre.

Plantation Kind No. VI.

Description.

Broadcast sowing after once simple ploughing and then harrowing and removing of ploughed up tufts of grass (all before sowing). No subsequent weeding. Only Hardwickia binata was

experimented with and the seed was as thickly sown as in Plantation Kind No. V.

Results.

The number of plants which have established themselves over the area treated (420′ × 6′) is 490, or 8,470 per acre.

PLANTATION KIND NO. VII.

Description.

Scratching a small trench in the ground about 1″ deep and 1″ broad and then placing the seed about 3″ apart in the trench. No weeding. Only Hardwickia binata experimented with.

Results.

The number of seedlings which have established themselves is 6 per linear 60′, or 1 per every 10′.

PLANTATION KIND NO. VIII.

Description.

Same as 7, only the seed after being placed in the trench was covered up with the soil which came out of the trench. No weeding. Only Hardwickia binata experimented with.

Results.

Number of seedlings which have established themselves is 20 per linear 60,′ or 1 per every 3′.

PLANTATION KIND NO. IX.

Description.

Placing the seed on the top of the unprepared ground and covering it with about 1″ of soil. No weeding. Only Hardwickia binata experimented with.

Results.

Number of seedlings which have established themselves is 5 per linear 60,′ or 1 per every 12′.

PLANTATION KIND NO. X.

Description.

Planting one year old transplants obtained from the Poona Manjri nursery which is distant about 200 miles by rail plus 8 miles by road: the plants were railed by passenger train and

were planted in previously prepared circular pits 9" deep and 6" diameter: the plant was held in position in the empty pit in one hand while the soil was replaced in the pit and round the roots of the plant with the other. Only Albizzia lebbek experimented with.

Results.

Three hundred transplants out of 7,000, or 4·3 per cent have established themselves.

PLANTATION KIND NO. XI.

Description.

"Forestry combined with agricultural." After preparation of the ground as for cereal crops, a cereal and a forest crop was sown in alternate strips. This kind of plantation requires a separate note to itself and I do not intend therefore to describe it in detail here: it is sufficient to say that when properly undertaken it proves successful for all the three species of this note.

III.—General.

These experiments are not in any way decisive as they have not been continued long enough and also are not (especially in the case of Plantation Kinds Nos. 1, 2, 5, 6, 7, 8, 9) on a sufficiently extensive scale. I have however made this note now because I expect to be going on leave in March and not to return to the Nasik Division and because I think systematic experiments somewhat on the lines should be carried out more generally. The importance of such experiments, and especially of their continuance, year after year, to determine the best and cheapest way of regenerating the different kinds of trees, is considerable, and I think that they should be started and conducted near the headquarters of most if not every Divisional Forest Officer under his personal supervision, careful notes on the results being made by him annually and reported to the Conservator and the Sylvicultural Member on the staff of the Imperial Forest Institute at Dehra Dun. It is of course the fact that artificial tree production can only be made use of on a comparatively small scale in India on account of the difficulty of getting money for the work, but

in the dry Deccan artificial production must be resorted to unless the stocking of the numerous, terribly poorly clad forests with trees which are suited to the locality and at the same time of good market value is to be relegated to an exceedingly dim future; and even if a Divisional Forest Officer may spend only a few hundreds of rupees annually on such work, it is well that such small amounts should give the best results possible. From my experience of Deccan Divisions I can say that a large portion of the money and care spent on artificial production has been thrown away on account of the methods used being unsuited to the locality, climate or species, and until experiments are systematically taken in hand to decide what methods are the best, money and trouble will perforce continue to be spent without much result.

28th January 1907.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

THE HABITS OF THE SWAMP DEER.

BY S. EARDLEY WILMOT, I.F.S., INSPECTOR-GENERAL OF FORESTS.

When lately on tour in the forests of the Central Provinces I was interested in the comparison of the habits of the Swamp deer of the South with those of the same species in Northern India. The former live in the glades of the sal forests which, dry in the winter, must afford no marshy lands and even little water in the summer. They seem not averse to a configuration of the ground which may be described as hilly, and often stony, even rocky. In Northern India, on the other hand, the Swamp deer resorts to the high grass lands of the river "Kadirs" in the rains, and gradually retreats to the sal forests in the winter and summer months, but is never found far from the neighbourhood of morasses where they may often be observed browsing up to their bellies in water, or even lying submerged with only head and neck above the surface.

Interesting as are these differences they might be assumed to be due merely to an enforced change from what one is accustomed to consider as the natural habitat and habits of these animals were it not that there is a most striking divergence in the type of antler sometimes observable as well as in the size of the individual and coloration of its hide. Plate 14, figure 1, shows a typical antler of Northern India which is nearly 38″ in extreme length. Figure 2 in

the same Plate depicts an antler, also typical as regards formation, of the Swamp deer of Northern India in the forward curve of the horn from which spring four tines, making with the terminal point and the brow antler, the twelve-antlered deer or "bara-singh." A similar formation in a more exaggerated degree is found in the brow-antlered deer of Burma. The specimen from which this antler was taken was shot in the Central Provinces and was in no wise different in size or color from the Swamp deer of Upper India.

Comparison is now invited to the antler at figure 3, Plate 15. This stag was shot in the same forest as figure 2, Plate 14, and was considered by its owner and by all the natives present to be a sambhar, a conclusion which the type of antler, its size, and color appeared to render reasonable. The two facts of well-furred ears, and of long pointed hoofs gave rise to some suspicion in classification, but that there was much similarity in outward appearance is attested by the fact that old sportsmen, European and native, could not agree as to the species.

Turning now to figure 4, (Plate 15, we have a magnificent ten-pointer of 40″ in length, with a girth of over six inches above the brow antler, carried by a very heavy stag of dark color. The antler shows none of the typical forward curve of the Swamp deer as shown in figures 1 and 2 in Plate 14. In fact, if the lower double tine, which is such as is never seen on the Swamp deer of Northern India, were bodily removed, a very decent sambhar antler would remain of which no sportsman could say that it showed any unusual variation from a standard type.

Seeing these last three animals together it struck more than one of our party, and that independently, that it was possible and even probable that a cross between two species of deer living under the same conditions in the same areas was not infrequent; not a fertile hybridism which would result in the alteration of the whole type of animal and antler in one locality, but a casual crossing which would account for individuals bearing such distinctions in size, color and antler as would invite the attention of the most unobservant, and puzzle the judgment of the most experienced. I leave it to others to pursue the investigation and to,

Photo. Mechl Dept., Thomason College, Roorkee.

FIG. 3. A 'BARA-SINGH' HEAD RESEMBLING A SAMBHAR.

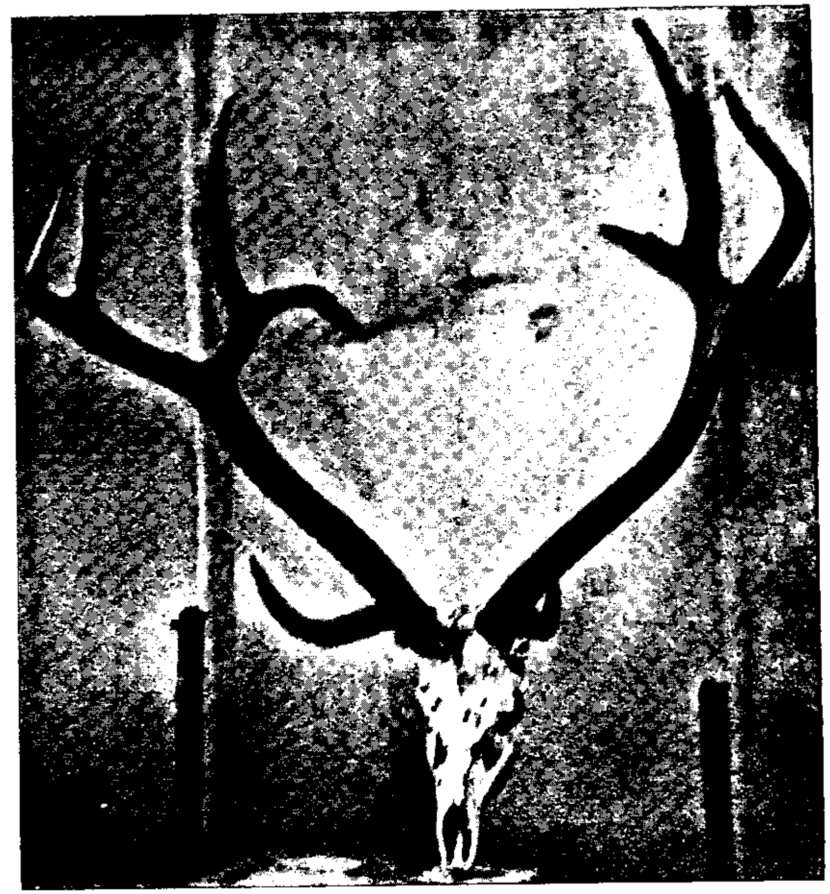


Photo. by S. Eardley Wilmot.

FIG. 4. A 40" TEN-POINTER 'BARA-SINGH'

if possible, procure practical proof, if they can influence the owner of any menagerie to attempt to produce a hybrid between these two species of deer. To me it appears to be a most interesting subject, the more so as change of habit from low-lying morasses, for which the Swamp deer is specially prepared by nature, to dry hills would, perhaps, in the ordinary course of events, result in the deterioration and not in the improvement of the species.

EXTRACTS FROM OFFICIAL PAPERS.

REWARDS FOR THE DISCOVERY OF THE CAUSE OF SPIKE DISEASE IN SANDAL.

No. R. 7493—*Ft.* 24 06-10, *dated 13th February* 1907. (*Revenue.*)

It is hereby notified for general information that the Government of His Highness the Maharaja of Mysore are prepared to pay a reward of ten thousand rupees to any one who will discover the cause of spike disease among sandal trees and suggest a thorough and effective and at the same time a cheap and easily applicable remedy for its eradication. This offer will be open for a period of three years from the date of this notification.

2. Every applicant for the above reward must forward his report of investigation, accompanied by microscopic slides, drawings, etc., to the Secretary to the Government of His Highness the Maharaja of Mysore, General and Revenue Departments. The following are the conditions to be satisfied before any claim for the reward can be admitted:—

(1) The cause of the disease must be definitely and clearly determined.

(2) An effective and cheap remedy, easy of application, must be prescribed.

(3) The remedy should be such as would perceptibly check within a year the spread of the disease.

All claims will be submitted to the decision of a committee of not less than three specialists, including Forest Officers to be appointed by Government; and the decision of the committee or of a majority of its members will be final.

3. Persons desirous of investigating the subject may obtain from the Conservator of Forests in Mysore copies of a printed compilation of important and useful papers bearing on the subject of the eradication of spike disease.

By order,
K. S. CHANDRASEKHARA AIYAR,
Secy. to Govt., Genl. & Rev. Depts.

NOTE ON THE BANDA FORESTS.

(Continued from page 158.)

III.

In addition to the mahua (Bassia latifolia) the chief trees in the jungles are—Dhawa (Anogeissus latifolia); Shej (Lagerstrœmia parvifolia); Tendu (Diospyros melanoxylon); Achar, which yields the chironji (Buchanania latifolia); *Haldu* (Adina cordifolia); Saj (Terminalia tomentosa); Sale (Boswellia thurifera); Tinsa (Ougeinia dalbergioides); Jamrasi (Elæodendron Roxburghii); Khair (Acacia catechu); Bamboo (Dendrocalamus strictus). In Marenyan-Panwari there is a little sal (Shorea robusta), but it is poor; and in the moister valleys there is generally some teak, but this also is of poor quality.

Other trees, shrubs and creepers of less common occurrence or less value are—*Dhaman* (Grewia vestita); Aonla (Phyllanthus emblica); Mohrain (Bauhinia vahlii, the elephant creeper); Bel (Ægle marmelos); Semal (Bombax malabaricum); Palas or Cheola (Butea frondosa); Karonda (Carissa carandus); *Pilu* (Careya arborea); *Bahera* (Terminalia bellerica); Gular (Ficus glomerata); Shisham (Dalbergia sissoo); Imli (Tamarindus indica); *Sirsa* (Albizzia Lebbek); Arjun (Hardwickia binata), rare; *Kesu* (Nauclea parviflora); Kosam (Sheichera trijuga); *Khawa* (Terminalia arjuna); Gotuba (Zizyphus xylopyra); Suna or Amaltas (Cassia Fistula); Dudhi (Wrightia tomentosa); Gabdi (Cochlospermum Gossypium); Kulu (Sterculia urens); Gurja (Garuga pinnata), yields Katila gum; Beri (Casearia tomentosa); Bhoti (Kydia calycina); Rori (Mallotus phillipinensis); Chamarkarar (Randia dumetorum, fruit used to poison fish); *Harsingha* (Nyctanthes arbortristis).

* In view of the nature of the forests no detailed working plan has been prepared, the forests being at present managed in accordance with a rough scheme drawn up by Mr. Blanchfield, Extra Assistant Conservator of Forests, in 1896. Under this scheme the system originally adopted was that of simple coppice with the proviso that all trees under 15 inches in girth were to be left standing as well as all mahua, achar, aonla and bel (these trees being useful for their flowers or fruit as a food supply). This scheme, however, was subsequently changed slightly, it being laid down that no tendu, mahua or achar was to be cut, and also that the Range Officer should mark for reservation trees under 15 inches in girth which showed promise of developing into good straight stems suitable either for timber or ballies. A rotation of 25 years was chosen as being the most suitable for the object in veiw (*i.e.*, a sustained annual yield of fuel), and the forests were divided into five working circles with an annual coupe aggregating 1/25 of the area in each circle. Hitherto owing to the poor state of demand it has been found impossible to dispose of the whole of the annual coupe in any one year and the fellings are very much in arrears. Of late years, however, the demand has been steadily increasing, and it is hoped that in a few years it will be possible to dispose of the whole area annually available. The coppice at present is disposed of at the price of Rs. 2 per acre, which is very low; with the steady increase in demand now growing up it is hoped that better prices will soon be obtained.

* *Bamboos.*—For working the bamboos the forests have been divided into 12 bamboo blocks, six of which are open and six closed every alternate year, so that in each year half the bamboo-bearing area is being worked over and the other half is resting. In order to guard against the extraction of entire clumps, it is laid down that no shoot of the preceding monsoon's growth may be cut, and to avoid congestion of the clumps, no bamboo may be cut at a greater height from the ground than 6 inches. The bamboo blocks are disposed of by auction, the bamboos being sold standing to contractors who make their own arrangements for extraction.

* For paragraphs thus marked I am indebted to Mr. Carr, Assistant Conservator of Forests, Jhansi.

* *Dry wood.*—Dry wood, both standing and fallen, is sold by auction annually block by block, the contractors making their own arrangements for extraction. No green tree may be felled.

* *Minor produce.*—Minor forest produce such as mahua, tendu, ber, chironji (fruit of the achar), honey, wax, hides, horns, gum, lac, etc., is sold on tender to the highest bidder, the purchaser, making their own arrangements for extraction. In the "pachpan-paintalis" forests the zamindars have the exclusive right to collect the whole of the mahua, and so much as they require for their own private use of the chironji, and of the fruits of the tendu and ber free of royalty of any kind.

* The following table will show the financial aspect of the Banda Forests during the past ten years:—

RECEIPTS.†

Year.	Reserved.		Forest.		Unclassed (*i.e.*, pachpan-paintalis forest).				Grand Total.	Expenditure.‡
	Major produce.	Minor produce.	Grazing.	Total.	Major produce.	Minor produce.	Grazing.	Total.		
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs	Rs.
1896-97 ...	759	660	501	1,920	6	143	40	189	2,109	4,364
1897-98 ...	701	828	417	2,006	106	157	17	280	2,286	2,915
1898-99 ...	651	2,157	852	3,660	134	314	34	482	4,142	4,181
1899-00 ...	673	2,597	517	3,787	86	324	2	412	4,199	4,393
1900-01 ...	933	2,603	613	4,149	128	41	37	206	4,355	5,608
1901-02 ...	861	4,254	627	5,742	367	538	79	984	6,726	6,315
1902-03 ...	2,518	3,662	692	6,872	717	413	67	1,197	8,069	4,915
1903-04 ...	3,209	4,466	751	8,426	635	535	231	1,401	9,827	5,134
1904-05 ...	2,841	3,360	1,144	7,345	1,307	255	55	1,617	8,962	5,565
1905-06 ...	3,887	2,023	959	6,869	2,263	527	390	3,180	10,049	6,299
Total ...	17,093	26,610	7,073	50,776	5,749	3,247	952	9,948	60,724	49,689

The value of these forests must, it must be remembered, not be judged by their financial results, though these have shown a considerable profit for the past few years. Their value is largely due

* For paragraphs thus marked I am indebted to Mr. Carr, Assistant Conservator of Forests, Jhansi.

† Receipts include the whole receipts from the "pachpan-paintalis" forests; expenditure includes the zamindar's 45 per cent in them.

‡ Pay of Divisional Officer and office establishment and other contingent (office) charges are not included.

to their improving the water-supply and providing a reserve of fodder and food for famine years (when grazing and mahua are granted free), and maintaining a regular supply of fuel, which would soon disappear if the zamindars were in possession, as is shown by the state of such jungles as are in their possession.

Grazing is permitted at the uniform rate of one anna per head per bull, cow, or bullock and 2 annas per head per buffalo. Although for three years from 1893 the grazing fees were doubled with a view to limit grazing, and it has been from time to time the subject of discussion, there is at present no limit to the number of animals that may graze beyond such as results from the imposition of the fees abovenoted. The only exception to this is that some 5,000 acres in Donda mauza have been absolutely closed to grazing. This block is in a very inaccessible corner, and it has been so closed since 1901 (G. O. No. 621 XIV-788 of 16th August 1901) in order to test the often repeated, but so far never proved, assertion that the Bundelkhand forests would, if closed to grazing, yield timber, etc., to a sufficiently increased extent to recoup the loss resulting from the prohibition of grazing.

In time of scarcity the forests are thrown open to free grazing for bovine animals (*i.e.*, not for browsers), and at such time the reserve of fodder thus made available is most valuable.

In addition to their vegetable productions, the forest areas contain a certain amount of mineral wealth in the shape of limestone and iron ore. Iron ore has been worked at the hills in Rajauhan, known as Harder, Khairar, Mathai, Bhusai and Renri and on the Chandha Pathar hill south of Kalyanpur; but it is many years now since the last furnace was extinguished, though the amount of slag found in many places shows the extent of former operations; but the competition of railway imported iron has been too much for the smelters.

Limestone is found at many places under the "ari" in the south of the Ranipur and Donda forests, especially at the Serha quarry in Kathauta-Mamaniyan and south of Kalyanpur. It also occurs at several places in Kulhua —(*Concluded.*)

4th September 1906.

THE CHIEF TIMER TREES OF INDIA.

(*Continued from page* 162.)

IV.

The fragrant yellowish-brown SANDALWOOD (*Santalum album*) is mainly confined to the dry region of Southern India. Its finest growth and development are attained in Mysore and Coorg, where the most oily and heavily-scented wood is found between 2,000, and 3,000 feet elevation. Its hard, heavy, oily, close-grained, and strongly-scented wood, so well known in the shape of carved boxes, frames, and similar small articles, is largely exported to Europe and Arabia, but most of it goes to China, to be converted into coffins for rich people. It is not a tree of large dimensions, as one of the largest known only measures 66 inches at 5 feet above the ground. The whole of the annual sales of this, the most costly of all the Indian woods per cubic foot, amount to only a little over 2,000 tons, having an export value of about £40,000, of which about 1,850 tons are produced in Mysore, 100 in Coorg, and 75 in Madras. In Mysore sandalwood is a royal monopoly, and most of the wood brought to market is cut in hedgerows and scrub jungles outside the areas demarcated as reserved forests. The proportion of the valuable scented heartwood is only about one-half of the log, while the unscented sapwood has little or no value. Even the fragrant sawdust or powder, used for distilling the sandalwood oil employed for perfumery and medicinal purposes, sells at the wood depôts for from £27 to £33 a ton. The tree is chiefly propagated by means of birds, which eat the fruit

and drop the seed from the branches where they perch. Here it germinates in the shade, usually coming up in wisps of a tree or two among bushes, through which it gradually pushes its way, though more quickly, of course, with artificial aid, in quest of the light necessary for its proper development as a tree surrounded with scrubby vegetation. Thus, if carefully protected against grazing and fire, it can be made to extend itself naturally on suitable land, its favourite situation being on a red and rather stony soil; and this method of cultivation, combined with judicious management of the existing forest areas, gives better promise of good future supplies of first-class wood than plantations are ever likely to yield, as the latter have proved unduly expensive and not really satisfactory in other respects. Hence, the most that is now done in this way is to dibble in seed in suitable places under the shade of other trees, and in prepared patches in clumps of bushes and scrub jungle. Planting in the open seems to fail invariably, as the seedlings require some little protection against the scorching power of the strong tropic sun. Its rate of growth varies considerably according to the given local conditions as to soil and climate, but old trees examined in Mysore have been found to give an average of a little over 9 annual rings per inch of radius. The system of working adopted in Mysore is to fell the trees at the age of 40 years, 8 inches being estimated as the average growth in girth per 10 years, and the minimum size of the mature tree being taken as 32 inches in girth at 4½ feet above the ground. In the sandalwood forests of Madras selection-fellings are annually made over one-tenth of the area, all dead and dying trees being removed as well as all mature trees above 32 inches in girth, and the roots of the same.

The RED SANDERS (*Pterocarpus santalinus*) of Madras has the least extensive distribution of any of the important Indian trees, as it is confined to an area of about 6,000 square miles in and around the Cuddapah district, where the annual rainfall is only about 42 inches, and the shade-temperature varies from 70° to 120°. Its extremely hard and heavy wood, of an orange-red colour when freshly cut, but deepening to a claret-red or almost black, are highly prized as house-posts, often being richly carved in the

houses of the rich, and for ploughs and other agricultural implements. Twenty years ago old dry pieces and seasoned rootwood were largely exported to Europe (over 15,500 tons, valued at £37,000, having been shipped in 1882-83), where this "redwood" was largely used in dyeing, the red colouring principle being the santalin soluble in ether and alcohol, but not in water. Dissolved in water it dyes silk a beautiful salmon-pink colour. Perhaps owing to want of suitable old-seasoned wood, but more probably owing to the discovery and manufacture of cheaper and gaudier artificial dyes, the export of Indian redwood (as of other natural dye-stuffs has fallen off very considerably, and is now of little value. But large quantities of the wood are used for carving and other ornamental purposes, as well as for furniture and carpentry, and the timber is in considerable local demand. It is a pretty tree, with a tall straight stem, and a high-set compact round crown of dense foliage, though, curiously enough, its leaves are impatient of the shade of other trees. It seeds in February and March, and natural regeneration from seed is easy, although, as in the case of teak and sál, and many other of the best timber-trees of India, the new shoots are apt to die off year after year until the increasing roots are able to throw out a shoot strong enough to resist the withering effects of the fierce sun and the scorching winds of the hot season. It also reproduces itself well by means of coppice-shoots and root-suckers. It grows best on the northern and eastern slopes of low ridges and spurs, on the stony soil of which the isolated poles of red sanders rise here and there above tufts of scented lemon-grass. The natural forests in the home of this tree are now being carefully protected against fire and grazing, while plantations have also been formed to provide increased supplies for future use. Planting is usually done with seedlings raised in small loosely-woven bamboo baskets, which are inserted into holes of suitable size dug in the ground, and are regularly watered during the dry season. Few observations have been recorded as to either its rate of growth or as to its attainable dimensions. Gamble mentions a plantation made in 1865, which showed in 1883, at 18 years of age, an average height of 40 feet

and girth of nearly 18 inches, with an average annual increment of nearly 3 tons per acre; but this is probably less rapid than its growth in the open natural forests.

Each of the Indian provinces, as indeed almost every tropical and sub-tropical country, has as its own peculiar "ironwood," some hard, heavy, and durable kind of timber. The chief of the Indian ironwoods are the PYINGADO (*Xylia dolabriformis*) of Burma, the NAHOR of Assam, or NAGESAR of Bengal (*Mesua ferrea*) and the ANJAN (*Hardwickia binata*) of Southern and Central India. The Burmese ironwood, PYINGADO, occurs abundantly in some parts along with teak, many other deciduous trees, and bamboos, in the dry forests of the lower hills, and is, next to teak, the most important of the timber-trees of that province. Under favourable conditions as to soil and environment, it grows to 90 or 100 feet in in height and 9 to 12 feet in girth, but on poor soil and in uncongenial situation (as in Arakan) it remains dwarfish and stunted—a description applying also to it in Godavery and the western coast of Madras, where it is also indigenous. The reddish-brown to dark-brown, close and cross-grained, very hard and heavy wood is exceedingly durable, and is much prized and largely exported for railway sleepers, the Burmese wood being in this respect much finer than that grown in Southern India, owing to the greater amount of resin contained in the former. Extracts made from the wood possess good tanning properties, and it is quite possible that the sawdust and waste wood in conversion might easily be turned into a profitable article of export. It produces seed abundantly, and seedlings spring up readily where the forests are protected from fire. The ANJAN of the dry forests of Southern and Central India, which also extends northwards into the southern portion of the United Provinces (and is found also in tropical Africa), is likewise a deciduous tree, but is to be found growing more or less gregariously in isolated belts and patches of various extent, and usually on sandstone. Its extremely hard and dark-red wood, streaked with black and often having a purple tinge, has, again like pyingado, its pores filled with resin, which tends to increase its weight and durability. It is extremely durable, does not warp, and is not

liable to split, while it is perhaps the hardest and heaviest of all the Indian woods. It is in all respects well suited for sleepers, bridge-construction, house-building, and ornamental work, but it is too hard and too difficult to work to be much in favour among the natives. It seeds freely, regenerates itself easily, and coppices well; but the seedlings and the shoots thrown up by the roots are billed off year after year by hot winds and fires, until finally one is found strong enough to withstand these hindrances to normal development. The NAHOR or NAGESAR of Assam and Bengal, on the other hand, is an evergreen tree, with beautiful foliage and fragrant white flowers. Though its true home is in Eastern Bengal and Assam, it extends far southwards into Burma, where it is known as GANGAW, and venerated as a semi-sacred tree. As it has been foretold in the Buddhistic sacred writings that the sixth and next Buddh will make his appearance under the shadow of a *Gangaw*-tree (as the fifth and last Gaudama attained the supreme knowledge of the Law while reclining under the sacred *Banyan*), it is to be found planted near monasteries all over the country, ready for the great event, should any of the monks happen to be the embryo Buddh. The dark-red and very hard and heavy wood is an exceedingly strong and endurable kind of timber; and it is only, as in the case of Anjan, its great weight, and its extreme hardness, and the difficulty of converting it with native tools, that accounts for its comparatively small use. It takes a fine polish and, having a beautiful dark grain, is suitable for high-class furniture and decorative purposes in Britain, much in the same way as the PADAUK (*Pterocarpus indicus*) of the Andaman Islands—which, by the way, is also obtainable of finer colour, texture, and dimensions in some of the deciduous forests of Burma (Toungoo district).

Besides the valuable kinds above described, the MAHUA TREE (*Bassia latifolia*) growing scattered throughout the deciduous forests of Central India, and extending thence south-westwards to Kanara, and northwards to Oudh and Kumaon, and also occurring in Upper Burma, is one of the most important trees in the districts to which it is indigenous. Its value depends less, however, on the excellence of its hard, smooth, durable, red wood than on

the edible qualities of the sweet, fleshy leaves of the corolla of its flowers, which, appearing in the hot season during May and June, form an important article of food throughout the forest districts where this tree occurs. The corollas are eaten either raw or cooked; they are used for making sugar; and a coarse and highly-intoxicating spirit is distilled from them, the odour of which is so strong and so unpleasant as to be noticeable at a long distance from the still. The average yield of corollas from a mature tree is about 200 lbs., which sell for about half-a-crown when collected. When eaten, they are mixed with other food, or with seeds and leaves of other plants, and they taste somewhat like pressed figs. The outer coating of the fruit is also edible, being either eaten raw or else cooked as a vegetable, and the inner coating is dried and ground into meal; while a yellowish-green, butter-like oil, which soon becomes rancid in the hot climate, is expressed from the kernel, and used by the hill-tribes or sold for soap-boiling. In this respect the mahua resembles the shea tree (*Bassia parkii*) of Western Africa, the "shea butter" obtained from which Mungo Park, the famous traveller, declared to be whiter, firmer, and richer in flavour than the best ordinary butter he had ever tasted, with the additional advantage of keeping fresh and sweet for a twelve-month without any admixture of salt On account of the edible value of its flowers and fruit, the mahua tree is worked with a view to these, rather than for its fine timber, and special provisions are accordingly made for the protection of the oldest and best trees growing in forests worked under a systematic plan. It seeds freely, and the fresh seed germinates well; but, being oily, its germinative power soon passes away. It is much cultivated either in avenues along road-sides, and in "topes" or clumps by itself or along with mango, and in such places it often sows itself spontaneously.

Nothing like the whole of the areas throughout which these chief timber-trees of India occur have been brought under the direct control of the Indian Forest Department, although the area at present administered by it amounts to close upon 120,000 square miles, over two-thirds of which, or about 81,000 square miles, (amounting to about one-twelfth of the total area of 945,000 square

miles of British territory), have been reserved and legally settled as permanent forest estates to be administered for the benefit of the people, and of their agriculture, and of the finances of the Indian empire. These great forest estates already yield a net annual income of about £500,000 a year, after payment of all charges directly or indirectly connected with the working, maintenance, protection, improvement, and increase of the marketable products they supply, and leaving out of consideration enormous quantities of timber, fuel, bamboos, grazing and grass, thatching material, etc., supplied free from payment to villagers resident in the vicinity of the reserved forests. This net revenue moreover, is steadily expanding under the careful husbandry of the well-trained and hard-working corps of officers forming the Indian Forest Service.—(*concluded.*)

THE SCARCITY OF CAMPHOR.

ITS EFFECT ON INDUSTRIES.

Camphor could at one time be bought for 50*s.* per cwt.; to-day it is worth 400*s.* per cwt., and it is extremely difficult to obtain in any quantity even at this price. The value has been steadily increasing during the last few years, but within the last few months there has been an advance of about 50*s.* per cwt. The bulk of the world's supply of camphor is used in the manufacture of *celluloid*, and it is this industry which is feeling the effects of the present famine most severely. As a substitute for ivory and tortoise shell, celluloid has become very popular, and manufacturers who make use of this substance in the production of such articles as knife-handles, billiard balls, pianoforte keys, combs, soap-boxes, and a hundred and one little novelties which are in great request as Christmas presents are almost unable to obtain even a small supply of an ingredient which is indispensable in the composition of these products. Some celluloid goods contain as much as 30 per cent. of camphor, and it is easy to understand how the celluloid industry is handicapped by its scarcity. The manufacture of smokeless powder is another industry requiring camphor, and during the Russo-Japanese War one of the reasons put forward for the small shipments of camphor from Formosa to

Europe and America was that the Japanese Government was holding back supplies for the purpose of powder-making. The price of camphor is now considerably higher than it was during the war, and therefore that reason in itself was not sufficient to account for the scarcity. There is also a large demand for camphor for medicinal purposes. It is one of the principal ingredients of a number of popular remedies, such as "camphorated oil," "spirits of camphor," "paregoric," etc.; is in general favour as a preventive against infection, and is used to prevent the attacks of moths on clothes. At one time a familiar sight in the streets was the hawker of penny "squares" of camphor; but he is no longer seen, because these penny "squares" are now worth about four pence. Thus the scarcity of camphor affects several industries and a wide range of popular commodities. And it will be interesting to inquire into the cause of the scarcity, for such inquiry will help us to form an opinion as to whether the article will in time disappear from commerce or whether the scarcity is only temporary.—*Indian Trades Journal.*

RUBBER PLANTATIONS AND THEIR PRODUCT.

THE NEW RUBBER AS VIEWED IN EUROPE.

The Government rubber expert of the Federated Malay States, Mr. P. J. Burgess, M.A., F.C.S., has completed his report on a visit of six months to Great Britain, to investigate the India rubber industry in its relation to the growth and preparation of raw rubber in the Malay peninsula. Being well introduced, he appears to have had no difficulty in gaining access to leading manufacturers and learning the details of manufacture, and also the views of the trade in regard to plantation rubber.

He states that he met uniformity of opinion among those who had practically made trial of Straits and Ceylon rubbers. All were agreed that the rubber was good and very serviceable, but by no means as good as South American fine Pará, either hard or soft cured. The plantation rubber is lacking in "nerve", it works soft between the masticating rollers, and its keeping qualities are inferior to South American Pará. After vulcanization the tensile

strength is less, and the elastic recovery of shape after deformation by stretching or compression is less perfect than shown by South American Pará under precisely similar conditions.

In several cases, notably at Silvertown, where accurate tests of all rubbers used are carried out, the recorded figures showed an inferiority of 8 to 15 per cent. with different samples of plantation as compared with native Parà rubber. The inferiority of the former was not confined to those physical properties capable of immediate measurement but was also shown in the keeping qualities of the rubber. Samples of plantation rubber two and three years old had all shown marked deterioration, whereas samples of South American Pará of ages up to and over 40 years had preserved perfectly their tough and elastic qualities. While this feature of plantation rubber may have been due to errors committed in preparation of the sample two or three years ago, it confirms practical users of rubber in their opinion that plantation rubber is not reliable, and certainly not the equal of South American Pará.

The cause of the inferiority of plantation rubber is not known. Some manufacturers believe it to be due to differences in the locality, climate, and conditions under which the trees have been grown; others that it is the result of different modes of curing and exporting; and again difference in the age of the tree from which the rubber is gathered may be the reason for difference in quality. Mr. Burgess makes a further suggestion, which he believes has not before been made. The rubber trees of South America, which are tapped, are the finest and most sturdy in the forest—the result of the survival of the fittest. Naturally only the best specimens become mature, and the native in tapping selects the best of the trees he conveniently can. On the plantation all the trees which survive the first planting are tapped on attaining sufficient size.

Mr. Burgess proposes to endeavour to ascertain, by tapping selected trees on the plantations, whether the rubber extracted is of finer quality than that of the average rubber on the same ground. To make his test more thorough he has had made in Manchester machines for practically working up and vulcanizing rubber, with which to make test-pieces of vulcanized rubber from the product of

trees grown in various localities, of different age, and cured in different ways, making likewise physical tests of such rubber and of samples of South American Pará.

Mr. Burgess does not feel in a position to say how rubber should best be coagulated and prepared for export, but is inclined to recommend that as little as possible in the way of acids be added to the latex. Where a washing machine is used, the milk might, he thinks, be allowed to coagulate by simply standing 24 or 36 hours. Manufacturers seem to object to the use of any acid during the rubber coagulation, for fear that traces of it might be left in the rubber even after washing. Whether the objection to the use of a volatile acid in coagulating rubber is really sound can only be decided by practical tests, but the objection does exist. But to avoid using any coagulant is only practically possible where a mechanical treatment of the rubber by a washing machine is in use, and then it is a matter for consideration whether the use of acid, which has been extremely convenient in assisting coagulation, should be discontinued from fear that such use will produce a rubber that will not stand the test of time, and which will perhaps injure in future the reputation of plantation rubber.

Before the introduction of the washing machine and the formation of crêpe rubber, drying had been a troublesome operation. Artificial heat had generally led to the softening of the rubber, and often, through inefficient control of the temperature, caused it to become "tacky." Crêpe rubber dries easily and well if hung in a dark but airy shed, and the preparation of rubber in this form appeared to have solved the old difficulties in drying.

There have been suggestions in regard to vacuum drying on estates, and Mr. Burgess investigated the vacuum drying of washed rubber in certain British factories. He reports that rubber dried in this way is softened by the heating, which is objected to by some manufacturers, though by those who have adopted vacuum drying this is not regarded as important, chiefly because the cause of softening is known and it is regarded only as preliminary to the softening which occurs in the mastication which is the next step in rubber manufactacture. But if plantation rubber were offered in

soft and adhesive masses, Mr. Burgess feels that serious objection would naturally be made. Taking into consideration the fact that plantation rubber is always inclined to be soft, he would not recommend any form of drying in which artificial heat is necessary, and which involved the elaboration of machinery and increase in power in doing what with washed rubber can be done in a more simple, safe, and natural manner.

By all the manufacturers seen in Europe, a lively interest was shown in plantation rubber and in the prospect of being able to obtain rubber of fine quality from the East. The immediate need is more quantity, and exaggerated views prevail of the amount to be expected in the near future from plantations. Manufacturers were not inclined to deal directly with the producer in small lots, the supply being too small and irregular to justify a departure from existing methods of buying, besides which plantation rubber requires different treatment in working. Unfortunately some of the plantation rubber has shown the defect of softness and tackiness, and these samples have tended to injure the reputation of plantation rubber. Manufacturers were without decided opinions as to the form in which rubber is exported. As long as it is dry and clear enough to show the absence of impurities, the form of the rubber was considered relatively unimportant. Preference for the crêpe form was shown by some, and most were agreed that this was as good a condition of packing and exporting rubber as any.

There is one danger connected with the use of a washing machine on a plantation, says Mr. Burgess. By its means adulteration with inferior rubber, rubber substitutes, and recovered rubber could be carried out without possible detection, by eye or hand inspection, although chemical analysis or practical use of the rubber would reveal the sophistication. In unprincipled and fraudulent hands such adulteration might be carried to a considerable pitch before detection occurred, and this possibility of misuse should not be lost sight of by those who are responsible for the purity of the rubber produced.

SMOKING PLANTATION RUBBER

The London rubber brokers, Lewis & Peat, who have from the beginning shown a special interest in the development of the market

for plantation rubber, handling an important share of the Ceylon and Straits product, write at length in *The Times of Ceylon* in regard to the proper preparation of this rubber. Their attention has been called to some lots of biscuits, apparently well cured, arriving in London in a heated and sticky condition, and the question has arisen as to whether the present mode of curing and the biscuit forms are the best. The firm regard this question of great importance, and they seek to impress upon planters the necessity of doing everything possible to establish plantation rubber on a sound basis as a competitor of the Brazilian smoke cured rubber, which "is still the standard and has maintained its character as the best up to this day, *viz.*, for elasticity, strength, and durability for general purposes."

It is essential, they say, that plantation rubber should be so prepared and cured that it can be used for all sorts of purposes by manufacturers. At present, so far as they can ascertain, it is only used for solution and small special purposes, and is not strong enough nor suitable for waterproofing or tyres and many other purposes that fine Pará is used for.

They have noticed sometimes cases arriving with the biscuits sticking together, and in some cases actually more or less compacted in one heated mass. This they attributed formerly to want of proper curing and drying, but they have been impressed by a theory put forward in the trade "that Ceylon pancakes and Straits sheets are at present made too 'pure'; that is to say, too much moisture, etc., is taken out of the latex, with the result that the elasticity and strength is reduced, and that it will be found that the rubber in this form will not keep, but will inevitably become soft and treacly if stored for any time or subjected to pressure and a raised temperature."

The author of this theory believes that it is the extra moisture left in the fine Para smoke-cured that renders it fit and strong enough for all purposes and accounts for its not deteriorating. His argument is that Ceylon planters should smoke-cure their rubber and make it into large balls as they do in Pará He also suggests that there are plenty of nuts in Ceylon that when burnt will produce the thick heavy smoke containing the active principle "creosote,"

which is the antiseptic which cures Pará rubber in Brazil. It is further suggested that while plantation rubber so cured might fetch less than the Ceylon biscuits and sheets do, the gain in weight in moisture left in the rubber would more than make up for the slightly lower price.

Lewis & Peat remark that they have seen Rangoon and Assam rubber, nicely washed and cleaned in India, arrive in London "a mass of heat," and with it other rubber from the same source, prepared by the natives, containing earth and other impurities, but quite sound and free of heat, suggesting that the cleaning weakened and destroyed the fibre of the rubber and thus unfitted it to stand the heat of a ship's hold or variations of the temperature.

The Times of Ceylon, in reproducing Mr. Gordon Waldron's letter in *The Indian Rubber World* in regard to smoking *Castilloa* rubber in Nicaragua, mentions that Mr. Alexander C. Devitt, a member of Lewis & Peat, who has been visiting Ceylon, inclines to the belief that plantation rubber from *Hevea* may one day be treated by smoke instead of by the method which usually obtain to-day.

CEYLON AND STRAITS PLANTING.

The report presented at the yearly meeting of the Ceylon Tea Plantations Co., Limited (London, April 26) mentioned 307,495 rubber trees on the estate, mostly among tea, though the company are now beginning to plant rubber extensively alone. During the year 5,596 of the older trees yielded 3,685 pounds of rubber, which brought an average of 5*s.* 11*d.*[=\$1·44]. Mr. H. K. Rutherford, the Chairman, said as far as he could make out, the prices at which rubber company shares stood, gave roughly an average value of about 10 shillings per tree of all ages. If this company adopted 5*s.* as a basis their rubber would be worth £75,000 as an asset.

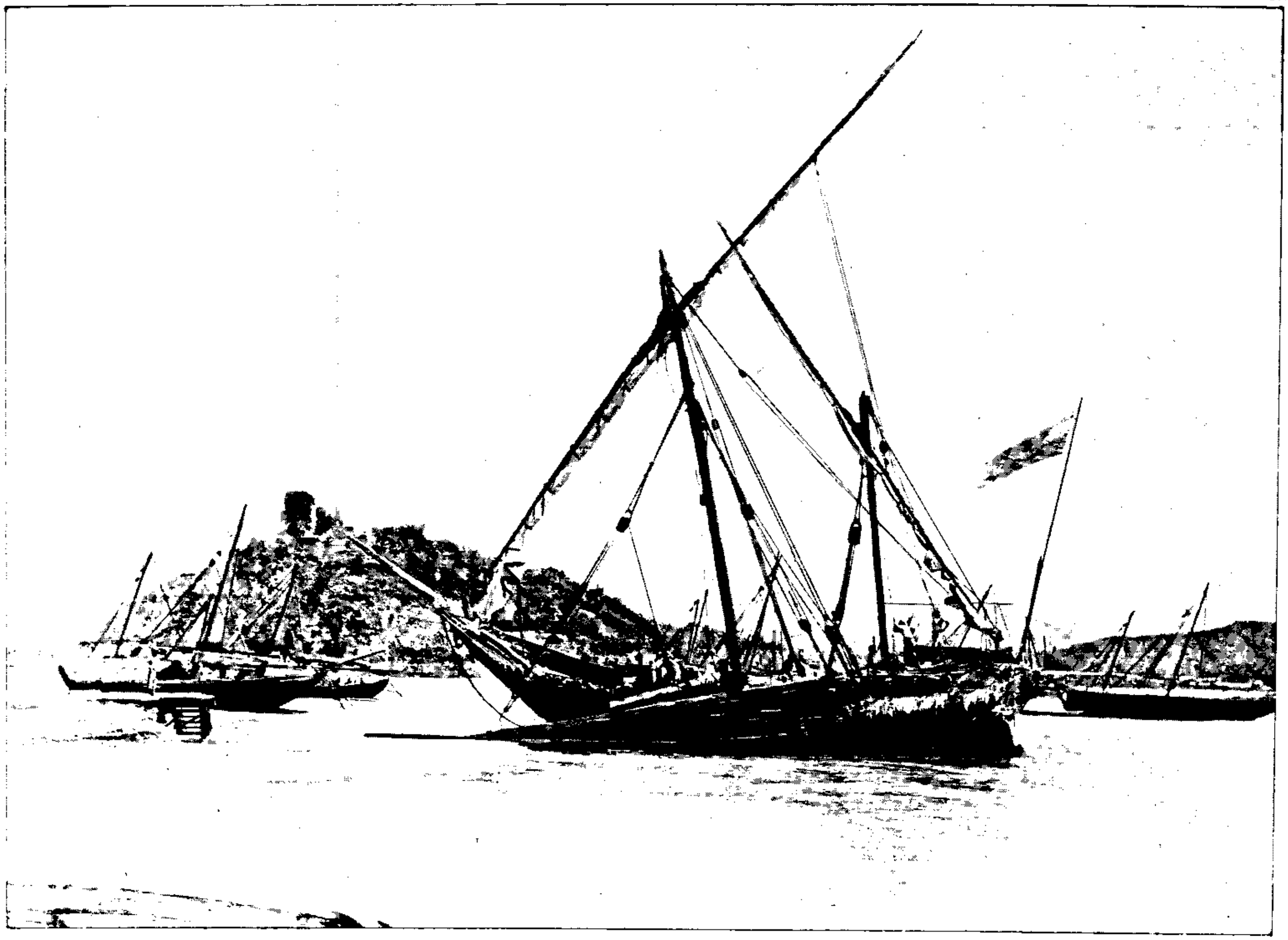
The Times of Ceylon has been making inquiries in regard to the exports of plantation rubber from the Federated Malay States, and finds that the Government has not completed the machinery for supplying exact figures, and it is a difficult matter for private enterprise owing to the number of seaports from which rubber is shipped, besides which a certain amount crosses the border into adjacent provinces.—*Indian Rubber World.*

JAPANESE METHOD OF PRESERVING WOOD.—Professor Taizan Shiza, Japanese Director of Forestry, has patented an invention for the *preservation of wood*, in the case of railway sleepers, posts, bridge timber, and so on. A number of capitalists in Osaka have formed a company to take up his discovery and establish an industry on their appreciation of it. Railway and other authorities are said to have given much attention to this subject, and will welcome an advance if it prove to have merit. Tar and creosote are understood to be the principal materials used in this case.

A METHOD OF PRESERVING FRUIT.—*Fruit growers in India* should note that by immersing ripe fruit for ten minutes in cold water, containing 3 per cent of commercial formalin, it can be preserved for some weeks. A series of experiments carried out at the Jodrell Laboratory at Kew prove the efficacy of this treatment. Even strawberries treated in this way, gave excellent results. Apples treated with the formalin solution kept sound for three months.

SERICULTURE AT MASTUNG.—The experimental sericulture started by Major Showers at Mastung in the Kalat State, Baluchistan, is being continued on a larger scale with results so promising that the industry may now be regarded as almost established. Great local interest in the work has been taken by the cultivators, the Sirdars, and His Highness the Khan himself, and its further extension and development into a lucrative and useful industry seems probable.

BAMBOO GRASS AS A MATERIAL FOR PULP IN JAPAN.—The Education Department of the Japanese Government, through the medium of the Agricultural College, has been making many experiments with the view of discovering a satisfactory native material for pulp, but without success. Latterly they have tried the young bamboo plant, or "bamboo grass," with very promising results. Former materials failed in the drying ; this dries readily. It grows in great profusion, and can be cultivated by the farmers as a branch of their work to any extent. If this discovery succeeds as it is expected, it will have a very interesting future.



TRANSPORTING TEAK LOGS ON THE BOMBAY SIDE.

Photo-Mechl. Dept., Thomason College, Roorkee.

INDIAN FORESTER

MAY, 1907.

INDIAN FOREST RECORDS AND MEMOIRS.

In a previous number of the *Indian Forester** we devoted some space to a consideration of the present position occupied by Indian Forest Literature and the methods existing for its publication. It was impossible under the conditions existing at that time to deal with the matter in any but unflattering terms to the Department, since in both amount and quality the Departmental Records of 30 years' work in India were of the most meagre description. Valuable information had been accumulated (it would have been impossible that this should be otherwise) and even recorded, but unfortunately the bulk of these observations is buried away in the pages of annual reports and old working-plans, neither of which are available to the majority of men in the Department itself and all of which are entirely outside the reach of others. Such has been the state of affairs in the past.

The present Inspector-General of Forests, who has effected many great and permanent improvements in other directions, has now set himself the task of attempting to remedy the deplorable

* XXXI, p. 607.

absence of Indian Forest Literature and we sincerely trust that the Department will seize with avidity the opportunities now afforded it of rectifying and removing one of the darkest blots on its claim to be a scientific service.

We publish elsewhere in this number a Circular * recently issued by the Inspector-General of Forests in which the subject of Departmental Literature is fully dealt with in a most satisfactory manner.

The Circular commences by detailing the part which the pages of the *Indian Forester* have taken in providing the principal medium through which subjects of professional interest have been brought to the notice of subscribers. In 1892 the magazine itself was supplemented by the "Appendix Series" to the *Indian Forester*. This series was issued by Government with the design of making available to the Department and others monographs on important subjects published at Government expense. These were circulated free, as they appeared, with the current number of the magazine. The Appendix Series undoubtedly filled in some degree a much felt want, although it was never made use of to the extent hoped, nor did the Department ever avail itself to the full of the undoubted advantages of the medium thus offered it.

In 1905 the Appendix Series gave way to the new series of "Forest Bulletins" which were started by the Inspector-General of Forests. This was a departure in the right direction as it gave a freer scope in the printing and distribution of copies, it being deemed unnecessary to distribute those dealing with subjects of importance only in a confined area on the same lavish scale as is necessary when a subject has a wide economic importance. Nine Bulletins have been published and two more are in the Press making a total of eleven.

Although the issue of Bulletins marked a step in advance it was felt that something of a more elastic nature, permitting of the publication together at one time of papers in several branches of Forest Science, was required if researches and observations not yet

* Circular No. $\frac{3}{290-4}$, dated Calcutta, 13th February 1907.

in a state of completeness were to be got out quickly and made available to other workers. This need became more urgent with the formation of the Imperial Forest Research Institute and a careful enquiry was instituted into the various forms of publication extant in India and elsewhere. This examination soon disclosed the satisfactory manner in which the Geological Survey of India publishes its researches and observations in the form of " Records " and " Memoirs," and the Inspector-General's Circular now informs us that the Government of India have sanctioned the proposal that the methods in force in the Geological Survey should be adopted in the Forest Department in order that publications containing important information may remain available for permanent reference and be issued in such form as would be most acceptable to the scientific world and most convenient for economic purposes.

The Circular describes fully the proposed method of publishing the Records and Memoirs and the distinction between them ; the former dealing with current literature, notes, etc., whilst the latter will be confined to completed papers of technical, scientific or economic interest.

We are of opinion that the Department, owing to the indefatigable efforts of our present Inspector-General, may now congratulate itself on being placed in a most satisfactory position for carrying out important and essential scientific and economic research work, and we trust that he will have the satisfaction of finding, in the great strides which will be made in the publication of forest literature, that reward which will alone repay him for his untiring efforts.

The Circular we notice is silent on the subject of the number of copies of the Records and Memoirs to be published, but we hope that the former at least will be distributed on a liberal scale.

SCIENTIFIC PAPERS.

ICERYA ÆGYPTIACA, DOUGL. ON TEAK IN BURMA.

BY E. P. STEBBING.

Whilst touring in Lower Burma in February 1905 I took some specimens of this scale insect, which was kindly identified for me by Mr. E. Ernest Green, Government Entomologist, Ceylon. It was found on teak trees in the Tharrawaddy and Rangoon Divisions.

The full grown female insect was first observed feeding on mature teak leaves in the Kangyi Forest in the Tharrawaddy Division on the 2nd of February. The insect at this stage is blunt-elliptical in form, pink in colour, covered dorsally with a white powdery and woolly substance and surrounded by a starshaped mass of white filamentous rays of a woolly consistency which give it a very characteristic appearance. Beneath the insect is pink in colour with black short legs and short black antennæ. Plate II in Vol. III of the *Indian Museum Notes* show this insect perfectly.

On the 8th of the month I again took the insect in the Magayi Reserve of the Rangoon Division—this time in an immature as well as in the mature condition. I was examining the young teak plantation of the year, 1900, for the attacks of the caterpillars of *Hyblæa puera and Pyrausta machæralis* when the scale insect was discovered. The mature female was attached to the woody shoots of the teak, each insect feeding in a solitary manner. The immature forms were found to feed clustered together on the mid ribs of the leaves, the rib having the appearance of being coated with snow. Beneath the long white cottony mass the scales were seen to be orange yellow in colour.

Immature stage—Blunt-elliptical, $\frac{1}{6}$ to $\frac{1}{8}$ inch in length, orange yellow in colour, with a white filamentous cottony edging all round.

The habit of the young is to cluster together on the food plant, the insects separating and feeding alone as they mature. As many as 50—70 young ones were counted in one cluster. The fully mature female appears to lose the cottony filamentous edging, the white powdery covering alone remaining at this stage.

The insect was also taken plentifully on *Dalbergia ovata* and *Pterosopermum semi-saggitatum*.

Icerya ægyptiaca was first reported from India in March 1893 by Mr. R. Newstead, Curator of the Grosvenor Museum, Chester, England, who had received some specimens from the Madras Presidency. The discovery was of very considerable importance since the insect had proved a most destructive pest at Alexandria, Egypt, where for the previous nine years it had caused the greatest alarm. In a letter dated September 10th, 1892, Rear Admiral R. W. Blomfield, R.N., wrote of this pest as "an eleventh Egyptian plague, which made its appearance at Alexandria in 1885, and has since proved most destructive to all kinds of vegetation. Origin unknown." It was first described by Mr. J. W. Douglas of Lewisham, England, in 1890. In Volume II, p. 256, of "Insect Life" Dr. Riley wrote of this insect : "Admiral Blomfield noticed it in quantities on the under side of the leaves of the Banyan tree, but it soon spread with extraordinary rapidity, and some of the most beautiful gardens of the city, full of tropical trees and shrubs, have been also destroyed. A breeze sends the cottony pest down in showers in all directions. It seems to attack almost any plant, but the leaves of *Ficus religiosa* and one or two other kinds of fig seem too tough for it and it will not touch them." Mr. Newstead's specimens were taken by Miss Tomlin on the under side of the leaves of a purple-leaved plant very like a coleus in the compound at Nungumbaukum, Madras, on December 13th, 1892, where it was very abundant. In the latter part of May 1893 the coccid was recognised in Calcutta by Mr. E. C. Cotes on some ornamental bushes in the Museum compound. The pest has also been reported from Chilaw in Ceylon by Mr. E. E. Green when it was taken on leaves of variegated crotons.

In July 1894 Mr. Cotes found that the coccid which, as has been stated existed in the Museum compound, was preyed upon by a coccinellid beetle which proved to be *Vedalia fumida* var· *roscipennis*, Muls.

A perusal of all available papers on the subject of this insect has failed to show that it has ever been previously reported from Burma. In view of the serious nature of its attacks, when it has appeared in an area favourable to its rapid increase, it would be advisable to keep close watch on its spread in Burma. It is not improbable that the drier climate of Upper Burma may be more favourable to such an increase than the damp hot one of Lower Burma.

ORIGINAL ARTICLES.

A PERMANENT METHOD FOR TREATING SELECTION FORESTS WITHOUT CALCULATING THE POSSIBILITY.

When an Indian forest of deciduous species suitable for treatment as high forest for the growth of timber (as opposed to coppice for the growth essentially of fuel) is first taken in hand it will usually be in a very irregular condition, with most of its mature trees removed, and with much badly grown timber in the crop. An Improvement felling is usually prescribed in order to eradicate the bad material where interfering with better and to allow the crop to mature.

People differ a good deal as to the details of an Improvement felling, but all agree in the central idea of removing badly grown stock to assist what is relatively better, and probably the only important difference lies in one point, whether, or not, any idea of felling with a view to regeneration should be admitted. We might then divide Improvement fellings into two classes, both irregular methods of treatment.

In the one which includes the idea of regeneration the following would be the main prescriptions :—

(*a*) Bad material, of whatever size, should be removed when it interferes (or is likely within a measurable time to interfere)

with better material, that is, whether as regards healthiness and shape, or species.

(*b*) Congested clumps of poles should be thinned.

(*c*) Even when there is no existing good young growth on the spot, inferior material, which is not too old to regenerate itself by coppice, and which is so placed that when a new coppice growth is substituted for it this new growth will not be in danger of frost or other risk, should be cut back.

(*d*) Over-mature or inferior trees not capable of coppicing, even when not standing over existing good young growth, should be felled, provided there are within suitable distance seed-bearers of good species, and provided the young seedling growth, when it appears on the ground thus laid bare, is not in danger of frost or other risk.

In passing it should be noted that if the felling rotation is a relatively long one it might be advisable to substitute "mature" for "over-mature" in the above prescription.

This felling I should call an Improvement Felling.

In the other class of felling, wherein the idea of felling to produce a regrowth is not admitted, and in which the aim is to improve the *existing* stock, while maintaining the cover as much as possible, only prescriptions (*a*) and (*b*) and (to prevent waste) that part of prescription (*d*) which deals with over-mature trees, would apply. *This form of Improvement Felling I should call a "Transition Felling."* It would generally only be applicable to a relatively short rotation and would be intended to carry the forest through a short transition period. Under this method mature timber, if still thriving, should be left to be utilised and dealt with in the regular method of treatment which is about to follow, while the immature bad timber not standing over something better, even when capable of coppicing, would be left untouched to cover the ground and close up the crop to be dealt with later when the regular method came in.

These methods are usually only *provisional*, and intended to be abandoned as quickly as possible when we pass on to a regular method—either the Uniform method (preferably called by D'Arcy

the "Successive Regeneration Fellings method"—or, shortly, "Successive Fellings"), or the Group method, or Selection.

It seems to me, however, that we might advantageously make of Improvement fellings a permanent system (though Transition fellings must of course remain provisional). This is what I propose to discuss in this paper.

When introducing either Successive or Group fellings, and especially the former, it will be quite impossible to make the regeneration fellings without sacrificing immature timber, for the forest will consist of trees of all ages mixed, and were we merely to fell the mature timber found in a coupe we should not obtain that regular succession of ages in the future crop at which we aim. It becomes neccessary to say—"We will consider, for example, the I, II, and III classes as constituting the old crop which has to be removed for regeneration purposes, while the IV and V classes will be absorbed into the new crop." It is even doubtful if we ought to retain the IV class trees, for probably the new crop will never be able to catch them up sufficiently before they have developed large crowns, so that when they mature, considerably before the end of a revolution, and are removed in the thinnings, their removal, besides causing damage, will amount to something in the nature of a Selection felling. For the V class possibly these difficulties will not be sufficiently marked to matter.

Now this removal of immature trees is in itself an unsylvicultural act, although the end to be obtained might justify it.

In introducing Selection into a forest which has been provisionally treated by Improvement or Transition fellings the difficulty will not be of the same kind. Were we to continue these provisional methods long enough we should eventually arrive at the Selection method, but with this difference, that we should be paying no attention to the main prescription of Selection, namely, the removal of a given number of matured trees, or given volume, annually; we should be treating the forest culturally (that is, just as it requires for its constant improvement from a sylvicultural point of view) without caring whether or not we were removing more than the possibility in any given year.

These remarks apply less to a Transition than to an Improvement felling, for in the former, while we remove over-mature trees, the rest of the operations merely amount to an improvement of the crop with practically no dimunition of the cover on the ground, and the crop remains complete, save where over-mature trees are felled. In Improvement fellings, on the other hand, we may in any given year sweep away great quantities of material (amounting perhaps to more than the annual increment of the forest) in order to obtain a better forest, whether grown from coppice shoots or seedlings—but *still* we act sylviculturally, and in the long run we obtain a better forest, and this, surely, is true economy.

Note that in all cultural operations, whether Improvement fellings, Transition fellings, or the Cleanings and Thinnings of a regular method of treatment, *no thought of the possibility enters.* In the case of Cleanings and Thinnings, however, the operations all tend to the survival of the best stems, which towards the end of the revolution will form a complete, mature crop, so that the possibility is not affected.

The aim of regular methods of treatment is to obtain a regular succession of age-classes, whether in even-aged crops (Successive or Group fellings), or in a mixed crop (Selection), and a regular annual outturn, the one connecting the other. At the same time great efforts are made to ascertain the future annual increment of the forest, when complete and normal, and so fix the possibility. Connect.

Equality of annual outturn is intended to supply the market with regularity, but purchasers do not always sell all the timber bought by them in the same year. On the contrary, they maintain stocks of timber, seasoning in their yards, and only sell when they receive offers which they consider sufficient. These offers depend on a variety of factors, such as the ability or otherwise of the people to spend money at any given time in repairing their houses, on the construction of a new railway, or of large works in the neighbourhood, and so on. This at once does away with the absolute necessity for an equal annual outturn, but even if this necessity did exist a very fair equality in outturn can be attained

by having several working sections, instead of only one, so that deficiencies in one are counteracted by surpluses in another.

Then as to the possibility by number of stems or by volume. This can only be an approximation, and probably a very poor one at that. We may, I think, dismiss possibility by volume as practically impossible of calculation in an Indian forest. For possibility by number of stems we make enumerations by size, classes, and this takes much time and costs a great deal. Then, in Selection forests, we intend during the felling cycle to remove all trees that are I class at the time of the enumeration, together with those II class trees which will mature during the felling cycle. To ascertain the latter we are forced to lean on very imperfect data indeed, so we sometimes halve the number of II class trees which we think will become I class in the course of the felling cycle, and fix a maximum number of trees to be felled in each *coupe*. If our enumerations show that by thus removing trees during the first felling cycle we are still in danger of finding a less number of mature trees during the second felling cycle we are told to retain some of the mature trees in our first felling cycle (this is laid down in D'Arcy's "Working Plans"). If, as usually occurs, the lower size classes are decidedly more numerously represented than the higher ones destined for felling, we consider we shall not be removing more than the annual increment of the forest by taking the mature timber. This is probably safe, but still we have not ascertained what the real increment of the forest, when complete, is, and this is ignored. When, as is usual, our enumerations are only partial, and do not embrace the whole area, our deductions cannot avoid being wild in the extreme.

Now it will certainly often be the case that when we come to fell in a coupe we shall find mature trees in excess of the maximum allowed for felling, just as we shall often find fewer. For although, with a complete enumeration, we can tell how the trees stand (by size classes) in the Working Plan *compartments* to equalise the outturn of *coupes* we cannot hold to the compartments, and must make the coupes overlap the compartment boundaries, so that we can only estimate the stock in the coupes. By using

very small compartments this can no doubt be improved, but the difficulty can never be quite obviated.

But not to fell trees that are mature is an unsylvicultural act, though perhaps not so bad as to fell immature trees. Maturity is the moment when the tree is ripe, and *ought* to come out, and it would surely be truer economy to realise it then, and place the revenue at interest in a bank, than to keep it standing because its removal will cause the total year's outturn to exceed the annual increment of the forest.

What precedes practically applies only to Selection, for it is not likely that anything but possibility by area will, in India, be applied to Successive and Group fellings, where each periodic block is to be cleared of its older crop and completely restocked with a new crop in a given number of years (the Period).

If, then, the fixing of a Possibility in Selection fellings can be done only in the vaguest manner, from long deductions and from questionable data, while it may often lead to work that is not sylviculturally correct, and if there is no real necessity for an equal annual outturn, may we not, in the case of species suitably worked by the Selection method, entirely dispense with the loss of time and money that enumerations involve?

If this were accepted, we should divide our forests into as few (probably equal-sized) coupes as we could manage, and simply apply Improvement fellings permanently, *thereby realising our trees as they matured here and there while constantly improving the condition of the crop.* I believe, though I cannot prove it, that in the long run a normality of age-classes would ensue. I believe also, judging from the appearance of forests which have for a considerable time been treated by Improvement fellings, that the crop will, *to some extent,* and more and more as time goes by, arrive at a condition of numerous groups of approximately equal-aged trees. This will be satisfactory for it diminishes the damage done by fellings, in crops of mixed sizes, which is the worst objection to the Selection method.

The method here propounded will have one great advantage in India. The attempt to regenerate a forest by drastic opening of

the cover to give light for a new, but at present non-existent, crop, is, in India, fraught with great risk from the growth of grass and weeds, and from frost, while the habit of many of our species of dying back for a succession of years renders a thorough opening of the cover, and consequent drying up of the soil, especially dangerous before the seedlings have become established. Once established they generally respond well to the admission of light. With the above cultural method this risk would not occur, and the seedlings would appear here and there and receive plenty of lateral shelter.

It will be noted that care has been taken to suggest this unfettered cultural method, only for species suitable for the Selection method, but Group or Successive fellings may suit some species better. In such cases I have nothing to say, and the sacrifice of immature timber when introducing these methods cannot be avoided. We are not here discussing the comparative merits of the various forest methods (personally I think there are some objections to Selection), but merely arguing that if Selection is the regular treatment prescribed, it can be best worked as a cultural method unhampered by a fixed Possibility.

To resume—there does not appear to be any necessity to insist on equal annual outturn, and with it normality in age-classes; a Possibility check by number of trees cannot be anywhere near accurately fixed, nor, *a fortiori*, a Possibility by volume, and may lead to unsylvicultural acts: it is true economy to fell a tree when it is mature, whenever that may be, and it is false economy to fell an immature, thriving and well-shaped tree. Therefore, for species to which the Selection method is applicable, there is no necessity for expending time and money, as at present, in making enumerations for Working Plans, and an Improvement felling based *only* on cultural considerations, in following out which the forest is constantly improving, is all that is wanted.

A. G. HOBART-HAMPDEN.

NOTE ON THE NATURAL REGENERATION OF ANOGEISSUS LATIFOLIA.

Owing to extensive areas being found covered in the Panch Mahal Division of the N. Circle, Bombay, with profuse seeding of "dhowra" (Anogeissus latifolia), of an apparently even age, the question was put forward as to its origin.

To arrive at any definite conclusion as to the cause and origin of this extensive young seedling growth, it is necessary to consider (i) the locality, soil and aspect, (ii) the type of forest in which it is found, (iii) the age of the seedlings, (iv) the rainfall at and about the time of their creation, (v) the production of the seed from which they sprung, and (vi) its germinating powers under various conditions.

(i) The locality in which this regeneration is to be found covers a considerable area. Thus it is found throughout the hill forests of Northern Godhra, in the central block of forests in Dohad, 50 miles S. W. of the former area, again, in the Karoda forests of the same range and also in the adjoining forests of East Jhalod. In such so-called hill forests, the hills are not more than from 300 and 400 feet above the level of the surrounding plain, the ground being very broken, and sides of the ridges being fairly steep and the nullas small and twisted. This excellent seedling crop may be said to be nearly always confined to the upper slopes or tops of the hills; in and round the level ground of the nullas only scattered seedlings are to be found here and there. The restriction to the higher levels of dense seedling growth is most marked, and this rule seems to be rarely, if ever, broken. Thus even on undulating ground, such as in BXI, c. 7, of Godhra or again in the Tunki forests of Dohad, where small stony hillocks occur, surrounded by deep black poorly-drained soil, the regeneration is clearly restricted to the hillocks. From the above remarks we may assume that, any how in these localities, the regeneration of "dhowra" is chiefly confined to well drained situations. A further proof of this may be found by the fact that "dhowra" seed germinated fairly on raised sandy beds in the Godhra nursery after being hand-watered whereas seed sown in

the sunk beds, which were irrigated, germination failed entirely, though care was taken not to wash the seed away or to damp it off.

As regards the soil, in the above described localities, it is not deep, though by no means poor. It is generally of a stony character, large irregular shaped bits of the underlying trap and quartzite rock being found imbedded and scattered over the surface. The character of the trap varies, sometimes being hard, fine-grained, little striated; in other cases it occurs as shale disintegrating rapidly and generally of a soft nature. The rock is nearly always intersected by veins of milky quartz, the outcrops of which not infrequently form the top of the ridges or hills; it is thus that many of the slopes are covered with loose fragments of quartz.

The aspect seems to have no influence on the occurrence of the seedlings; in B.L.XII Godhra I have it as noted growing well on a south aspect; in Dohad and Jhalod Ranges it was found flourishing both on a north and south aspect and in the chain of Jhalod on the eastern slopes, also on the same aspect in places in the Godhra Range.

(ii) We now come to the type of forest growing on these hills.

It varies little; some species appear in nearly all the forests, others are found in one and not in the others. Of the species which appear fairly regularly may be mentioned Teak, of which old trees in many places are scarce owing to their having been killed outright or partly so, in the drought of 1900, and have since been cut out. The next most common tree is "dhowra" itself. Together with these are found large timber (*Diospyros melanoxylon*, bia (Pterocarpus marsupium), kalam (Stephegyne parvifolia), sirrus (Albizzia lebbek), kalia-sirrus (Albizzia odoratissima), palas (Butea frondosa), mohin (Odina wodier), helderwa (Adina cordifolia) and phassi (Dalbergia paniculata). The other species which often occur in such forests, but which cannot be said to be always present as is the case with the above are sissum (Dalbergia latifolia), kakra (Lagerstrœmia parviflora), moka (Schrebera swietenioides), gotbor (zizyphus xylopyra), sadada

(Terminalia tomentosa), bheda (Terminalia belerica), umb (Saccopetalum tomentosum), hewar (Acacia eucophlœa), and smila (Bombax malabaricum). Generally speaking on the appearance of salai (Boswellia serrata) and kadai (Sterculia urens) replacing some of the other species, owing to the poorness of the soil, the dhowra regeneration is conspicuous by its absence, even on the hill tops. The undergrowth in such forests, besides seedlings of dhowra, bia, sirrus, sissem, moka and some teak, which cover a good percentage of the ground, is of either sali (Nyctanthes arbortristis) or kedo (Holarrhena antidysenterica), and with these a light though tall crop of grass. Lastly, in some of the forests bamboos (Dendrocalamus strictus) occur, under which, if dense, dhowra seedlings are not found. The whole of these forests are generally speaking not densely stocked, but give one more the idea of having been treated for coppice with standards, where the standards were liberally reserved, or again looking to the seedlings on the ground, it is not unlike a seedling felling in which the groups of seedlings are fairly advanced and the final seedling felling is about to take place. These forests were formerly dense but have been much opened out by the heavy mortality due to the drought of 1900. The effect of opening out these forests and letting in the light is a factor to be considered in connection with this even aged seedling crop. From notes taken on this point I find seedling of dhowra appear to stand considerable lateral shade, and even slight vertical shade, however, from the straightness of dhowra poles growing up amongst the older and larger trees and from the lanky appearance of young trees noticed in "tight places" it appears to seek the light in more advanced age. This is further found out by the fact that old trees in very open situations have a natural tendency to branch and be crooked. In any case the seedling now under discussion have ample light.

(iii) We next come to the age of the seedling and this point is even more interesting than their occurrence in such large quantities. The seedling are, nearly without exception, of even age throughout the area, nor are seedlings of other ages noticeable in the least when compared with the majority, and it is not until we

come to poles of fair size that we meet with another class. From the list of the following seedlings examined and cut, and these over a large area, it will be seen that the age varies between 4 and 5 years. The seedlings chosen for this purpose were taken so as to represent, as far as possible, those of all sizes belonging to this group, the readings being taken in the year 1905.

1. Three seedlings cut and examined in BXII, c. 15, Godhra Range, were found all to be 5 years old, 8 to 10 feet high, and 3 to 4 inches basal girth, found growing on a hillock.

2. Three seedlings cut in BX, c. 6, Godhra, were all 4 years old, found growing on a hillock, in a dense mass of other dhowra seedlings.

3. One dhowra seedling cut in BXI, c. 7, of Godhra, on well-drained soil was 4 years old, 7 feet 4 inches high, 14 inches basal girth.

4. In BXIII, c. 3, of Godhra, three seedlings cut were found to be 4 years old.

5. In BXIII, c. 8, of Godhra, two seedlings were examined and found to be 5 years old.

6. In BXIII, c. 23, of Godhra, four seedlings were examined and found to be 5 years old, varying in height from 2 to 10 feet.

7. In BXIV, c. 6, of Godhra, three seedlings were examined and found to be 5 years old, one being 2 feet high, another 5 feet high and the last 9 feet high.

The above are extracts from my field note book, and I have a note to the effect that I cut not a single one of another age, though the seedlings chosen varied from very small plants to those of 10 feet height. Besides those given above I cut and examined a large number both in Dohad and Jhalod Ranges of which I have no record made at the time, but as far as I can remember I found none of other ages.

Now turning to the second group of even-aged dhowra, we have scattered over this area, but not so prominent as the above groups of even-aged pole woods. They have been recorded as growing in the Taragora and Sarda forests of Jhalod, where they were first noticed, then again in Kasoda forests of Dohad. On

finding similar sized straight poles in groups in BXIII, c. 10 of Godhra, on the upper slopes and top of a hill, I cut down a few to determine their age. The annual rings being distinct they could be carefully counted, and gave the following ages in 1905 :—

	No.	Height of tree.	Girth as 4 ft. from ground	Age.	Locality.
Nos. 1 to 3 out of one group.	1	25′	11″	20 years.	BXIII, c. 10. Godhra Range.
	2	25′	11″	20 years.	Do.
	3	15′	8″	19 years, one year indistinct.	Do.
No. 4 from another group 200 yards away from 1st group.	4	26′	13½″	20 years.	Do.
Another forest	5	20′	11½″	20 years.	BXIV, c. 6.

Such sized trees have been noticed in other forests, such as BVII, c. 23, and again in the Tunki and Kodwa forests of Dohad, but I can find no note as to if I took measurements, though I feel certain I did so at the time and found the trees all to be 20 years of age.

As has been stated before other young aged trees are to be found here and there, but they are on the whole conspicuous by their absence, and not until you come to nearly mature trees do you find dhowra in great numbers. The above two groups only being found goes to prove that dhowra regeneration in the Panch Mahal is not of yearly occurrence, but appears to be confined to certain years and those coming at considerable intervals only.

(iv) On having definitely fixed the age of these groups, it is not unnatural to turn to the rainfall of the year of their germination for the solution.

Taking the case of the oldest seedlings of 5 years old, the seed from which they were produced would be that of after the rains of 1899, the germination taking place during the rains of 1900 and the first ring would be formed in 1901, while the fifth ring was formed in 1905 (the year in which the seedlings were examined).

They are now, therefore, in their 7th year and the seedlings showing 4 years of age at the time of examination would have

germinated in 1901. Looking to the statement of rainfall of 1900 (attached), the rain began early in June and good, though not really heavy, rain fell on at least three days of this month. Looking to other years this is exceptional, as June in the Mahals is generally characteristic of no rain until the last week and then generally only a thunderstorm. The next three months of this year gave continual showers and two or three heavy falls. This equally distributed rainfall over three months, with no exceptionally heavy fall, and specially the light fall in June and the first days of July must have done much in helping once germinated seedlings; in fact the distribution of the rain could not have been better for dhowra seedlings. The total for the year was 32·13" against an average of 39" for the head-quarter station of Godhra.

Turning to the rains of 1901, June showed one heavy fall on the 25th; such a fall would by no means favour dhowra regeneration as much of the seed would be washed away. On the other hand, July and August showed good rain and September, though short, had one good fall, which would favour seedlings had they come up.

The two year's rainfall so far considered must have been the years in which the germination occurred. We must now examine the year before and after this period. The year 1899 produced rains which are too well known to want describing; they failed hopelessly and only 3 or 4 inches being recorded. The rains of 1902 were characterised by a heavy fall in July, two heavy falls in August, one in September, and generally much rain throughout those months. With the exception of these heavy falls, the rains of 1902 would be favourable, but from the case with which dhowra seed is spoilt by heavy rain, and also its being easily washed away, I should be inclined to put them down as a bad year for dhowra regeneration. I have tried to obtain the rainfall of the year in which the 20-year-old poles should have come into existence, but the records are unluckily destroyed.

(v) Having dealt with the rainfall for the present, we now come to the production of the seed.

Dhowra, as a rule, seeds profusely every year, so that one would expect anyhow a fair show of seedlings each year, provided

the rainfall was favourable, but this, as has been seen, is not the case. Now I have great doubts as to the fertility of the seed produced every year. My reasons for thinking this to be the case are firstly, the very fact of seedlings of all ages not being found in the forest, and secondly, the great difficulty in making dhowra seeds germinate in the nursery. As stated in the first part of this note, seeds sown on a raised sandy bed germinated only to a moderate extent, while seed sown in sunken and irrigated beds germinated not at all. To more clearly show the relative amount of seeds which germinated in raised beds, it may be stated that only 182 seedlings came up from sowing one pound of seed and in another case 247 seedlings came up from a similar amount of seed. Now a pound of dhowra seed I estimate to contain well over 10,000 seeds. I base this calculation on the fact that 6 separate pounds of teak seed gave an average of 1,166 seeds per pound after being dried in the sun for a month, and putting a low estimate of 10 dhowra seeds to equal one teak seed in weight, the pound of dhowra seed would contain over 10,000 seeds. Thus, if this is correct, only 1·82 % and 2·47% of dhowra seed germinated under most favourable circumstances, and when the danger of the seed being washed away or rotted by excessive damp were practically nil. From the above it may be assumed that dhowra seed, as a rule, is anything but fertile in usual years. It remains still to be explained why seed was produced in 1899 and 1900 which must have been in a large measure fertile and from which the even-aged seedling crop now to be found so extensively was produced.

It is well known that either hacking the stem of a tree or pruning it, or in any way giving the tree a shock which is liable to retard its growth or even kill it eventually, is a fairly sure way of making it produce a superior crop of fruit. Without a doubt such conditions were brought about by the failure of the rains in 1899. The drought of that year killed trees, both of dhowra and other species, throughout these jungles, and where they did not kill them outright the trees were left much damaged. I was not in the Mahals during that year so I have no records of what

took place, but in the Satpuras the drought had the effect of making the bamboos seed profusely out of rotation; I also noticed teak and mowra seedling profusely in that year. As the dhowra in the Mahals was much affected by the drought, it is not only possible but also very probable that the trees finding themselves in danger of being killed or severely damaged went one better than in usual years and produced large quantities of fertile seed instead of barren seed which I think is their usual custom.

(vi) If the above theory is correct that under normal circumstances dhowra produces little or no fertile seed, but that the seed produced after the trees had been heavily tried in 1899-1900 was fertile, the even-aged crop of dhowra now to be found in the forest would be accounted for, especially as the 1900 rains were favourable. The four year old seedlings may well be accounted for in the same way, the trees being in a very weak state again produced a certain amount of fertile seed after the rains of 1900, and after that the trees either died or so far recovered as to again return to their normal condition. In summing up the above facts which it has been necessary to state in detail, it appears that, 1st dhowra likes a well-drained situation and good amount of light; 2ndly, that these conditions are naturally useless without the production of fertile seed backed by fair rains; and 3rdly, the yearly crop of seed of dhowra is by no means always fertile. It has been put forward that this even-aged regeneration was due to some special distribution of the rain. I am, however, in favour of the theory that dhowra, though producing seed yearly, rarely produces great quantities of fertile seed except under special conditions.

Statement showing rainfall for 1900:—

		In.	Cents.	
January 1900.				
Nil.				
February 1900.				
Nil.				
March 1900.				
Nil.				
April 1900.				
8th	...	0	26	
9th	...	0	26	
				0·52
May 1900.				
Nil.				
June 1900.				
9th	...	0	41	
11th	...	0	12	
26th	...	0	13	
				0·66
July 1900.				
6th	...	0	2	
12th	...	0	02	
13th	...	0	75	
14th	...	0	02	
25th	...	2	86	

July 1900—(*contd.*)

Date		In.	Cents	Total
27th	...	0	33	
28th	...	0	05	
29th	...	0	10	
30th	...	0	87	
31st	...	0	30	
				5·32

August 1900.

Date		In.	Cents	Total
1st	...	0	83	
2nd	...	0	23	
3rd	...	0	35	
4th	...	0	9	
5th	...	0	64	
6th	...	2	96	
7th	...	0	40	
8th	...	0	06	
9th	...	0	35	
10th	...	0	30	
11th	...	0	99	
12th	...	0	56	
13th	...	1	21	
14th	...	1	5	
15th	...	0	42	
16th	...	0	55	
17th	...	0	2	
18th	...	0	2	
20th	...	0	6	
21st	...	0	38	
22nd	...	1	21	
23rd	...	0	56	
24th	...	0	39	
25th	...	0	15	
26th	...	0	17	
27th	...	0	08	
28th	...	0	30	
29th	...	0	29	
30th	...	0	2	
31st	...	0	30	
				16·4

Statement showing rainfall for the years 1901-1902.

January 1901

Date		*In.*	*Cents.*	Total
8th	...	0	6	
14th	...	0	3	
				0·9

March 1901.

Date		In.	Cents.	Total
23rd	...	0	5	
				0·5

June 1901.

Date		In.	Cents.	Total
25th	...	3	55	
26th	...	0	4	
				3·59

July 1901.

Date		In.	Cents.	Total
3rd	...	0	6	
7th	...	0	25	
8th	...	0	7	
9th	...	0	3	
10th	...	0	37	
11th	...	0	55	
13th	...	0	11	
14th	...	0	7	
18th	...	0	29	
19th	...	0	4	
20th	...	0	19	
21st	...	0	18	
22nd	...	0	6	
25th	...	1	12	
26th	...	0	87	
27th	...	0	11	
38th	...	0	74	
20th	...	0	3	
31st	...	0	34	
				8·48

August 1901.

Date		In.	Cents.	Total
2nd	...	0	8	
3rd	...	0	22	
4th	...	0	1	
5th	...	1	4	
6th	...	1	83	
7th	...	0	68	
8th	...	0	34	
11th	...	0	5	
13th	...	0	15	
14th	...	1	17	
15th	...	1	75	
16th	...	0	18	
17th	...	0	4	
18th	...	0	9	
19th	...	2	50	
21st	...	0	14	
22nd	...	0	17	
23rd	...	0	2	
29th	...	0	3	
30th	...	0	3	
				11·49

September 1901.

Date		In.	Cents.	Total
5th	...	0	1	
10th	...	0	5	
13th	...	0	4	
21st	...	0	5	
				1·15

October 1901.

Date		In.	Cents.	Total
17th	...	0	3	
18th	...	0	1	
				0·4

	In.	Cents.	
Total for the year 1901 ...	24	89	

January 1902.

		In.	Cents.	
9th	...	0	1	
13th	...	0	10	
15th	...	0	7	
16th	...	0	1	
19th	...	0	3	
				0·22

July 1902.

		In.	Cents.	
5th	...	0	70	
7th	...	0	74	
9th	...	0	20	
10th	...	0	5	
13th	...	0	9	
14th	...	0	3	
15th	...	0	30	
16th	...	3	45	
17th	...	1	29	
18th	...	0	5	
19th	...	0	3	
31st	...	0	5	
				7-11

August 1902.

		In.	Cents.	
12th	...	0	6	
20th	...	0	25	
21st	...	0	44	
22nd	...	0	57	
23rd	...	0	84	
24th	...	0	3	
25th	...	0	52	
26th	...	0	2	
27th	...	3	75	
28th	...	3	13	
29th	...	0	31	
30th	...	0	4	
31st	...	0	26	
				11-42

September 1902.

		In.	Cents.	
1st	...	0	20	
3rd	...	7	79	
4th	...	0	63	
5th	...	0	6	
6th	...	0	22	
7th	...	0	55	
11th	...	0	7	
12th	...	0	29	
16th	...	0	57	
17th	...	1	10	
18th	...	0	56	
19th	...	1	9	
20th	...	0	73	
21st	...	0	50	
22nd	...	0	6	
				16-42

October and November

Nil

December 1902.

		In.	Cents.	
12th	...	0	15	
13th	...	0	50	
				0-65

	In.	Cents.
Total for the year 1902 ...	36	16

September 1900.

		In.	Cents.	
1st	...	0	15	
2nd	...	0	1	
3rd	...	0	2	
5th	...	0	60	
6th	...	0	59	
7th	...	0	19	
8th	...	0	38	
9th	...	0	60	
10th	...	0	1	
11th	...	0	1	
12th	...	0	2	
14th	...	0	5	
19th	...	0	57	
20th	...	0	1	
21st	...	0	23	
22nd	...	0	47	
23rd	...	0	1	
24th	...	0	5	
26th	...	0	24	
27th	...	0	1	
28th	...	0	4	
				10-19

October 1900.

Nil.

November 1900.

Nil.

December 1900.

Nil.

NAUTLYS : RALPH S. PEARSON,

N. Wales, 13th January 1907. *Deputy Conservator of Forest.*

Photo.-Mechl Dept., Thomason College, Roorkee. Photo by Mr. Carlho.

A primitive method of moving timber on the Bombay side.

TIMBER TRANSPORT ON THE BOMBAY SIDE.

I beg to send for publication in the *Indian Forester* two photographs showing the following operations :—

1. One of the photographs shows the hauling up into the Kodibag Forest Depôt of teak logs from the Kalinadi river and the measuring of them by the Forest Depôt Officer.

2. Showing the loading of teak logs on country vessels in the Kodibag Bunder. The log that is seen in the photograph measures 175 cubic feet, and is being pulled up by Khalasis with the aid of pulleys and ropes tied to both ends of the log. The tonnage of the vessel is 70 tons. The pier to the left is in front of the Custom's Office, Kodibag Bunder. The hill forming the background is situated on the other side of the Kalinadi river, and projects into the sea. On the top of the hill stands the travellers' bungalow.

I hope it will not be out of place to mention here that I do the exploiting work of Government and deliver all the girdled teak at the Kodibag Forest Depôt.

All timber in the Kodibag Forest Depôt is sold by the Forest Department annually after the rains by public auction. Most of the girdled teak is purchased by Messrs. A. Brown, of Malabar Timber Yards & Saw Mills, Ltd., Kallai, and Messrs. Alex. McKenzie & Sons, of Byculla Saw Mills and Timber Works, Bombay.

V. A. COELHO.

[We also reproduce a photograph depicting the Burma method of piling timber by the aid of elephants. It seems somewhat surprising that the exceedingly primitive methods shown in the photographs should be in force on the Bombay side at the present day.—HON. ED.]

CORRESPONDENCE

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

KASHMIR TROUT FISHERIES.

The Kashmir Durbar has for some years been experimenting with a view to introducing brown trout and rainbow trout into Kashmir waters. The idea originated owing to a liberal offer of the Duke of Bedford to provide the ova from England. For some time the experiment was carried out by Mr. Frank Mitchell privately, and the success which has eventually been obtained is practically due to his pertinacity and the enthusiasm which he has displayed in the experiment. At first the ova were hatched out in Srinagar itself, but this was found unsatisfactory and it was difficult to obtain a copious and constant supply of pure water. In 1900 the experiment was tried in one of the small canals leading out of the Harwan stream. Misfortune, however, continued to dog the footsteps of the experimenters as large quantities of *débris*

were brought down and the whole of the hatchery enclosure was swept away.

In the winter of 1901 the Durbar, after some persuasion agreed to make one last attempt and a final supply of brown trout was brought over from England. It was found that the rainbow trout ova could not stand the long journey by tank from the sea board.

Mr. Mitchell then, with the permission of the Durbar, constructed hatcheries and tank just above the Harwan Reservoir. He placed them at a fine spring, as he had found that spring water was more suitable owing to its purity than river water. These trout hatched out very well, and at last the promise of a really favourable result seemed certain. Once more, however, he was doomed to misfortune. For in 1903 came the great abnormal flood and the river burst into the hatcheries and carried all away. However, by this time the trout were big enough and able to look after themselves, and the only result of the flood was to distribute them into the Harwan nullahs and Dhal Lake. Here they have continued to thrive wonderfully, and within four years of the start trout weighing 9lbs. have been caught with the rod, and the Viceroy had the pleasure of seeing and eating a male trout weighing 12½lbs. and measuring 27 inches from nose to tail and with a girth of 18 inches.

The Harwan stream and Dhal Lake as well as the stream leading into the latter are now all very well stocked, and the Achabal stream has been stocked this year. What is of the greatest importance is that it is found that after three years the trout are breeding freely, and Mr. Mitchell has, with the assistance of the Durbar, constructed a very good hatchery safe from all possible floods. The hatchery is placed near two springs giving a very good supply of water, and there are tanks above for the young fish and below for the breeding fish. The Viceregal party were much interested to see these latter at their morning meal, beautiful specimens weighing 10 lbs. jumping right out of the water for the food thrown to them. They were also much interested to see how they were sorted according to age and size. Mr. Mitchell has lately

been home to England, visiting all the hatcheries there, and getting the benefit of all the latest ideas and experiments, and now that he has once more come back he has trained a staff of Kashmiris, who are able to carry out his instructions so that the fertilisation of ova is now carried out by artificial means with entirely satisfactory results.

The undertaking has now passed from the experimental stage, and in a few years the rivers of Kashmir will be stocked by British brown trout, and as in the short space of four years they have attained the size of 12lbs. we may confidently hope that they will grow to a very large size, and that trout of 20lbs. will be as common as they are in New Zealand. These trout at present take the small fly spoon and phantom bait according to the season, and take best when the river is high and the snow water is coming down when, of course, the mahseer are out of the question. It is hoped that those interested in pisciculture and also the authorities will not lose the great opportunity that the devotion of Mr. Mitchell and the public enterprise of the Kashmir Durbar has afforded them of stocking the hill streams of Upper India, such as those of Simla and Naini Tal, with a fish that not only affords the noblest of sports, but provides a food supply of the highest quality to that part of India which it is most difficult to provide with fish at present.

EXTRACTS FROM OFFICIAL PAPERS.

THE PUBLICATION OF INDIAN FOREST RECORDS AND INDIAN FOREST MEMOIRS.

Circular No. $\frac{3}{295\text{-}4}$.

FROM

S. EARDLEY-WILMOT, Esq.,
Inspector-General of Forests to the Government of India,

To

THE CHIEF CONSERVATOR OF FORESTS, BURMA.
" " " CENTRAL PROVINCES
ALL CONSERVATORS OF FORESTS (EXCEPT THOSE IN BURMA AND CENTRAL PROVINCES)
THE DEPUTY CONSERVATOR OF FOREST, COORG.
" " " " " ANDAMANS.
" " " " " NORTH-WEST FRONTIER PROVINCE.
" EXTRA-ASSISTANT CONSERVATOR OF FORESTS, BALUCHISTAN.
" " " " AJMER.
ALL OFFICERS OF THE IMPERIAL FOREST RESEARCH INSTITUTE AND COLLEGE.

Calcutta, the 13th February 1907.

SIR,

I HAVE the honour to address you on the subject of the future publication of departmental literature comprising the results of investigations and research by members of the Imperial Forest Research Institute and of other members of the Department, as well as of those who not being attached thereto, possess information of value which they are desirous of permanently recording. In the past the pages of the *Indian Forester* provided the principal medium by which subjects of professional interest were brought to the notice of a limited public, and in 1892 the "Appendix Series" to the *Indian Forester* was commenced with the design of placing at the disposal of members of the Forest Department and others monographs on important subjects published at Government expense and circulated free of cost with the departmental magazine.

In 1905 the Appendix Series gave way to Forest Bulletins, and since then 9 Bulletins (which have had a much wider circulation and have, judging from the demand, supplied a much-felt want) have been issued.

2. With the constitution of a Forest Research Institute and the development of scientific investigation in the Forest Department, the necessity of placing Indian forest literature on a more satisfactory footing has become apparent, and the Government of India have sanctioned a proposal that the same methods as have proved so successful in the Geological Survey Department should be adopted in the Forest Department, so that publications containing important information may remain available for permanent reference and be issued in such form as would be most acceptable to the scientific world and most convenient for economic purposes.

3. In future therefore the pages of the (1) Indian Forest Records and of the (2) Indian Forest Memoirs will be open to those who desire to secure for their research and investigation a permanent place in Indian forest literature whence it will be available to all those interested in the science of Forestry. Forest Bulletins will no longer be issued and the following procedure will be observed in regard to the preparation and issue of Records and Memoirs which, it is hoped, will be effective in making the new departure the success which it should attain with the wealth of material available :—

(1)—*Indian Forest Records.*

(i) The Records will be printed on a page $9\frac{3}{4}'' \times 7\frac{1}{2}''$, and will consist of approximately 60—70 pages per Part. Each Part will be illustrated by reproduction from photographs or negatives, either as wood blocks (for simple line drawings), or by the lithographic, half-tone or collotype processes.

(ii) No definite date for the issue of the various Parts of the Records would be fixed, since no satisfactory objects appear to be gained by rigidly adhering to a monthly, quarterly or any other period. The advantages of a hard-

and-fast date of publication would seem to be more than counterbalanced by the disadvantages which might accrue either from publishing a Part made up with inadequate materials owing to the fact that sufficient papers are not available, or from keeping back important papers and notes for several months to fulfil unnecessary stipulations imposed by a publishing time limit.

(iii) Four Parts would conveniently form a volume of the Records which will then be bound up with title page, etc.

(iv) The Records will be devoted to the publication of papers giving the results of the local investigations of the Research Institute Staff, or of others whether members of the Department or not, together with any short notes on preliminary research, the publication of which may be considered of advantage to aid others in carrying out further observations in the subject under enquiry. Notes and observations supplied by Forest Officers on such matters as the effects of exceptional seasons on forest growth, the seeding of the valuable species of trees sudden attacks of serious pest, etc., will find place in the Records.

(v) The Records will deal strictly with professional matters and should form a valuable current exposition of the work of the Department which will be of interest and utility alike to the members of the service and to scientists and those interested in Forestry throughout the world.

(2)—*Indian Forest Memoirs.*

(i) The Memoirs will be published in quarto size, $12\frac{1}{4}'' \times 10''$. The size used by the Royal Asiatic and other Societies and by the Geological Survey of India, etc. The use of the quarto appears to be advisable as it allows, where necessary, of full-sized reproduction or of the preparation of a plate upon a scale commensurate with the requirements of the author. The Memoirs will be illustrated and the process of reproduction will be similar to those

used in the Records save that the photogravure process will be also resorted to, where necessary.

(ii) Each issue will consist of one, two or more Memoirs or Monographs. The Memoirs will be bound up into volumes of about 300 pages excluding plates. A title page for the whole volume and one for each of the Memoirs it contains will be prepared and inserted before the volume is issued. Each Memoir will be separately paged at the top, the entire volume being paged at the bottom, the number being placed in square brackets.

(iii) The Memoirs will appear only when suitable monographs for reproduction in this form are received. They will be devoted to the publication of complete and important monographs on particular subjects. For example, Memoirs dealing with careful research made into the sylviculture of a particular species of tree or with a family or genus of insect or fungus pests or the description of new species; researches into the formation, growth and economic uses of a particular gum, dye, tannin, etc.

(iv) The Memoirs will be kept strictly technical, and will be open to the papers of all authors having a scientific or economic bearing upon Indian Forestry.

4. For the present and until the new system of publication is placed on a satisfactory footing, all papers and illustrations intended for insertion in the Records and Memoirs should be sent to the Inspector-General of Forests at Calcutta whence proofs will be forwarded to the authors before publication.

I have the honour to be,

SIR,

Your most obedient Servant,

S. EARDLEY-WILMOT,

Inspector-General of Forests.

MISCELLANEA.

WOODS AND FORESTS IN THE SOUDAN.

The desirability of establishing forest reserves has been fully considered in previous reports and I am well aware how much value your Lordship attaches to this important matter, but hitherto want of staff in the Department of Woods and Forests has been the principal difficulty.

In my notes on "Agriculture and Lands," I have referred to the heavy work entailed on Mr. Broun (Director of Woods and Forests) owing to the double functions he was called upon to perform as acting Director of that Department also. The appointment of Mr. Bonus as Director of Agriculture and Lands will now allow Mr. Broun to devote his energies to his own Department with, I am confident, the best results for its development and progress.

It takes a very long time to get Forest Officers trained in Europe and there is no prospect of obtaining more from India, as the Forest Service there is said to be under-manned. A student from Coopers Hill, Mr. Bisset, is about to join the Department.

Mr. Wood has been occupied in exploring and selecting areas for reservation, and has up till now selected 22 forests in the Sennar Province, and of these four have already been taken in hand and demarcated.

These four areas represent about 83,000 acres or 130 square miles. The selection has been carefully made in order to provide an ample area for the present wants of the Nomads, and in future selections it is important to keep this point always in view, for herds are certain to increase and in time the necessity may rise for limiting their herds to suit the grazing areas.

The want of reserves in other parts of the Soudan is also badly felt, and the Governors of Berber and Kassala are anxious to follow the system now adopted in Sennar.

Mr. Wood has started fire protection in the four reserves by subsidising the Sheikhs of the adjoining villages for cutting the fire lines and selecting forest guards from the same villages.

Amongst the many matters awaiting the attention of the much-worked Legal Department, is the Forest Ordinance, and pending its promulgation certain regulations are about to be issued, making it possible to carry on the work of fire protection. These can be withdrawn when the Ordinance is issued.

Under the sub-headings of "Gums and Resins," "Rubber," etc., I have referred to the steps that are being taken, under Mr. Broun's direction, to develop the commercial value of these natural products. The following further remarks, extracted from his report on Rubber and other Seeds, are interesting and instructive :—

"Some 22 different kinds of seeds were distributed to various "parts of the Soudan with the request that the annual reports "should contain details regarding the success, or otherwise, of the "sowing. I regret to say that in many cases no information has "been given to me as regards either the success of the seeds sent "this year, or the progress of seedlings from plants sent in previous "years. As these seeds are sent for experimental purposes, it is "extremely desirable that correct records be kept for future "guidance, and also for the information of those who have so "kindly contributed them to this Government, as, for instance, the "Inspector-General of Forests to the Government of India; the Principal Forest Officer, Cyprus; Mr. Gibson of the Khedival Agricultural Society, and others.

"Among the most important of the seeds were those of the "Ceara Rubber tree (*Manihot glaziovii*). These were distributed "to Bor, Renk, Omdurman, Dongola, Kassala, Berber, and the "Bahr-el Ghazal, and also to Khartoum, Mudiria and Experimental "Farm. The seeds put in at Khartoum germinated freely, although "some took about two months to do so, even after soaking. The "plants are now of varying heights up to 7 feet. They have done "in Dongola and are up to 2 feet high, while in Berber only three "are said to have come up, and in the Bahr-el Ghazal, none. From "Bor and Renk I have so far received no reports.

"The other seeds which I have received, and of which test "samples tried by myself have been fairly successful, are :—The "rain tree (*Pithecolobium saman*), teak (*Tectona grandis*), Ceylon

"lilac (*Meliadubia*), Indian Tulip tree (*Thespesia populnea*) and "Trincomalie wood (*Berrya ammonilla*). These, however, with "the exception of Ceylon lilac, do not seem to have come up "elsewhere, judging from the few reports which I have received, "and I can only suggest that too early results have been expected, "as I found that several kinds took a long time to generate. "The Governor, Dongola Province, has made experiments to "find out the best time for sowing, and for this and other matters "his excellent report must be referred to. He mentions that the "seeds of 'Cordia Abyssinica' Gimbil, some of which were sent "to him by Mr. Armbruster from Kassala, has given the best "results of all. This is a tree with excellent timber, which is "largely used for cabinet-making and is here known as 'Soudan "Teak.'

"It has been decided to make small experiments with seeds "of various kinds of rubber. As regards Landolphia owariensis "and Ceara rubber, as above stated, experiments have already been "started. There still remain Para Rubber, Castilloa, Funtumia, "and Ficus elastica. These are to be sent to the Provinces in "which there is any likelihood of obtaining any success, and it "is hoped that correct data regarding their growth will be kept. "It is, however, not certain that the trees, even if they grow up "well, will yield much rubber; we shall have to wait for five or "more years before we can see the results and it is for this reason "that the experiments must be made on a small scale. For "example, both the Ficus elastica and the Ceara rubber grow well "in Ceylon, but they do not yield much rubber, and the yield of "Para rubber in Ceylon is also said to be smaller than in the Malay "States."

With regard to timber operations, an experiment will be made in 1906 with a large saw mill now in course of erection at Wau. A portable circular saw and 9 h.-p. engine are also being erected at Sherif Ahmed in the Sennar Province, with a view to supplying the local Government demands for planks and beams.

Between £E. 300 and £E. 400 have been received on account of Boat Building Licenses.

Royalty on firewood cut by Government Departments has been reduced from Pt. 1 per kantar to Pt. 8 per cubic metre, which has been adopted as the standard measurement for firewood sales in the past year. The value of some 76,000 cubic metres of firewood cut in the first nine months of 1905 amounted to upwards of £E. 10,000, which represents a decrease of some 6,000 kantars under 1904.

In spite of the opening of the Nile-Red Sea Railway and probably substitution of coal for wood as fuel, Mr. Broun does not anticipate that the demand for firewood will be much reduced and in anticipation of the possible rise in the price of wood, he suggests the creation of a central depôt for the sale of both firewood and timber, and urges the importance of attempting rafting operations on a large scale from the Upper forests, and especially on the Blue Nile.

He is now engaged on an extended tour in these districts, and the result of his observations on these possibilities will be awaited with much interest.

PRICE FETCHED BY CEYLON BLOCK RUBBER.—Mr. Spencer Brett, a London broker, took home with him from Ceylon last month, by arrangement with Dr. Willis and Mr. M. Kelway Bamber, a consignment of Ceylon Block Rubber prepared from wet biscuits, and a cable has now been received, states the *Times of Ceylon*, announcing that it was highly reported on and fetched 5*s.* 6*d.* per lb. This price was obtained at the same time as "Culloden" realised 5*s.* 9¼*d.* and other leading Ceylon marks 5*s.* 7¼*d.* Taking into account the additional moisture in the block rubber in question, Dr. Willis declares that the price represents 4*d.* per lb. more than most of the other plantation prices and considers that the market price of Ceylon rubber can be increased if producers will adopt the new system. This successful experiment, which arose from the suggestion by Dr. Willis in his concluding lecture on the lessons of the rubber exhibition, certainly promises very valuable results. It supplies definite grounds for the opinion that the retention of a proportion of moisture is an advantage; and it pays, adds the Ceylon paper, to ship home water at 5*s.* 6*d.* per lb.

Strips of Melia Azadivachta and Albiggia Lebbek 3½ years old originally sown in conjunction with agricultural crops.

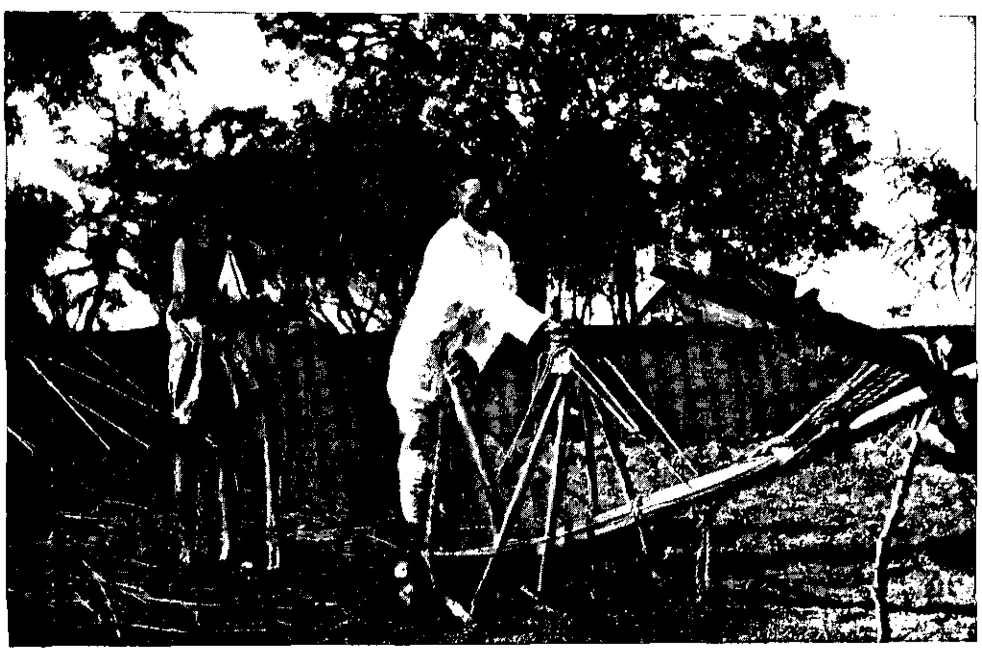


Photo-Mechl. Dept., Thomason College, Roorkee. Photos. by L. S. Osmaston.

PABOR WITH MOGRA ATTACHED.

VOLUME XXXIII NUMBER 6

INDIAN FORESTER

JUNE, 1907.

THE SYSTEM OF AGRICULTURE COMBINED WITH FORESTRY IN THE DECCAN OF THE BOMBAY PRESIDENCY.

1. In the Deccan proper of the Bombay Presidency wood is much wanted if only for providing as a substitute for the cowdung cakes universally used for fuel to the great detriment of the agricultural crops, which have reached their limit of poorness on account of continued want of manure.

2. The sources of wood at present are very scanty for—

(1) There is little tree growth on private lands.

(2) The lands taken up for forest are more than 30 miles east of the West Ghauts and, excluding the Khandesh Satpudas and the Hardwickia binata forests of Khandesh and Nasik, provide little wood. For the following reasons such lands come under three heads:—

(a) Exceedingly poorly stocked scrub hill forest: it will take generations before these forests are improved sufficiently to provide an appreciable yield of wood.

(*b*) Lands in the plains which were under occupancy and cultivated till the Famine of 1877 but were then relinquished and reverted to Government; such lands are practically devoid of trees.

(*c*) So-called "Babul forests," the best of which are on river banks and subject to floods and fairly well stocked with trees, chiefly Acacias and Zizyphus jujuba: the forests in this 3rd class are very small and only found here and there and the supply of wood from them is nothing like sufficient, in fact where they are chiefly in evidence (in the Poona District) the great bulk of the yield is consumed by the Poona city and the cantonment market and does not reach the villages of the Poona District at all.

(3) The lead from the Western Ghauts and Konkan Hills is too long for the firewood of these forests to be of use in supplying Deccan villages.

3. Unless the supply is at hand and very cheap the villagers will never buy wood for fuel. In fact even when the wood is felled and stacked and close at hand, the average Deccan villager is loath at present to buy, and this because for centuries he has looked on cowdung as his fuel and he does not understand the wisdom of putting his hand in his pocket to buy wood when cowdung is to be had: in short, he wants teaching that it will pay him financially to buy wood on account of the increased agricultural crops which he will reap from manured ground. No doubt this lesson the villagers will learn when the wood is available, and meanwhile it seems to me to be the duty of the Government to do their best to provide it.

4. This can be partially done by stocking the lands classified under head (*b*) with trees suitable to the locality, and the answering of the question as to how this stocking can be carried out is the object of this note.

5. I have been a Forest Officer in the Deccan Division for a good many years and the only method of stocking these dry, bare

plain forests which I have found successful is that of agriculture combined with forestry.

Three and a half years ago I started this method in the Nasik District and can now record the results of the experiments.

6. I will first describe how agriculture combined with forestry plantations should be conducted in view of the lesson learnt from the plantations so far undertaken, and then some description will be given of the plantations from which the lessons have been derived.

METHOD I.

Giving out of the land to lessees.

7. Departmental operations should only be conducted when lessees cannot be obtained: it will probably be found that when lessees will not come forward, it will be best to carry out a plantation on part of the area departmentally, the villagers will then see from the result that it is a paying concern and will come forward as lessees, for these fallow lands yield excellent crops.

Length of lease.

8. The length of the lease should be two years: in the first year the lessee should be allowed to sow the whole area with his own crops; and in the second year forestry and agricultural crops should be sown in combination. The result of this will be that the land is well cleaned of grass and weeds before the tree seeds are sown.

Preparation of land for sowing.

9. All promising trees should be reserved from felling: other trees to be disposed of as follows:—

(*a*) Trees which coppice well to be cut level with the ground and their stumps left.

(*b*) Other trees (*e.g.*, most if not all acacias) to be felled and their stumps uprooted.

(*c*) Thorn bushes to be cut down and uprooted.

(*d*) The resulting material from such fellings to be sold, the lessee being paid at the rate of 8 annas per 100 c.ft., rough stacked, for his labour.

The land should be prepared for sowing by the usual ploughing and harrowing operations, and before such operations the area may be burnt over under supervision so long as there are very few existing trees to be damaged by such burning: this burning will much facilitate the subsequent ploughing, harrowing and cleaving of the land.

Sowing.

10. The tree seeds are provided by the Forest Department. The "Pabar" is the ordinary instrument used in the Deccan for sowing cereal crops. The seed is put by the sower into a wooden saucer-like receptacle in which four holes have been drilled, each of these holes being connected with a hollow bamboo, down which the seed falls on the ground. The bamboos when they approach the ground are about 1 foot apart which is therefore *the distance between the crop lines. The "Pabar" is drawn by a* pair of bullocks. If the seed is too large to go through the "Pabar" then an instrument called a "Mogra" is used; in the case of the "Mogra" the saucer-like receptacle for the seed has only one central hole which is about ½ inch diameter and connected with a hollow bamboo or piece of hollow wood through which the seed falls to the ground, thus only one line can be sown at a time with one "Mogra;" if the "Mogra" is to be used it is either pulled by hand or tied behind the "Pabar," and in the latter case there must be one man holding the "Pabar" and one man holding each "Mogra," so that if each of the four lines of a strip is to be sown by "Mogra" there must be four men employed on the sowing work, whereas one man is sufficient for sowing by "Pabar." Sowing by "Mogra" is thus more expensive than sowing by "Pabar" alone. It is far easier to sow the agriculture and forestry crops at the same time, but it is most important to get the tree seeds into the ground before or during the first break of the monsoon, so that the seedlings get the benefit of the full rainy season and so get strong enough to resist the great trial of their first hot season. The lessees, however, will not sow their grain until the first rains have fallen, for unless the ground is suitable for immediate germination the seed will be liable to damage by animals and

birds. To accommodate the lessee the sowing may be allowed during the first good rain but not later. The seed of Melia azadirachta cannot be sown till about the second week in July, as the seed does not ripen till then and must be sown in the year in which it ripens. The proportion of forestry crops to agricultural crops should be as 1 is to 3, one line of tree seed alternating with three lines of agricultural seed. The best way to sow is for one hole in the receptacle of the "Pabar" to be plugged up, this hole corresponding to the tree seed line; the agriculture seed can then be sown through the three remaining holes and the tree seed can be sown by "Mogra" behind the bamboo corresponding to the plugged hole, or in case of very large seeds which will not pass through the "Mogra" by hand. In this way the forestry crop lines will be about 4 feet apart as the distance between lines sown by "Pabar" is about 1 foot.

Plate A shows a "Pabar" with a "Mogra" attached.

Weeding.

11. The lessee should be bound to weed the area twice, once about the end of July and once in September; but unless the grain crops are a failure he will naturally undertake the necessary weeding for his own sake The weeding should be by hand and not by the oxen-drawn instrument called the "Kalape" or "Landgi."

Species to be sown.

12. The species I recommend for head "b" lands referred to in paragraph 2, section (2), are Hardwickia binata, Melia azadirachta, Albizzia Lebbek and Tamarindus indica.

General.

13. The lease should be free, no rent being charged. Lessees should be bound to protect the land leased to them from cattle, grazing, fire and theft. Lessees who carry out the work well should be given preference when giving out further leases.

METHOD II.

14. Method II differs from Method I in that the tree seed is sown in the first year of the lease, there being no first year of

agricultural crops only : also the forestry and agricultural seeds are sown in alternate strips, the forestry strip 4 feet broad (1 Pabar's breadth) and the agriculture strip 8 feet broad (2 Pabar's breadth) : there is thus 8 feet between each forestry strip, and in each forestry strip are four lines of seeds about 1 foot apart. In the second year of the lease the lessee can sow his agricultural crop as during the first year, but he has to keep the forestry strips well weeded by hand and to sow up by Mogra, or by hand, any blanks with new tree seeds which will be given him for the purpose : if the Mogra be used for sowing it must be drawn by hand and not by bullocks as otherwise the existing seedlings will be damaged.

COMPARISON OF METHODS I AND II.

15. Both the methods are now being tried in the Nasik Division, and the experience gained is not yet sufficient for one to judge finally which is the better of the two. So far, however, experience goes to show that Method I should be followed when the ground is covered with a tenacious deep-rooted grass, such as "Kunda" or a weed such as "Kusmada," which necessitate extra working of the soil before these species can be eradicated.

The advantages of Method I over Method II are :—

(1) The ground is more thoroughly cleaned before the seeds are sown.

(2) The tree seeds, when sown, are more evenly scattered over the area.

(3) The lessee gets more from his agricultural crop per acre and is therefore correspondingly pleased.

(4) There is no danger of damage to the tree seedlings by the plough cattle during the second year of growth.

The advantages of Method II over Method I are—

(1) There is a chance during the second year of filling up blanks in the forestry strips.

(2) For numerous obvious reasons (possible transfer of officers, death of lessee, etc.), it is an advantage to get tree seed in during the first year of the lease.

(3) The tree seedlings of the first year get a weeding during their second year of growth.

16. It now remains to give a short description of the plantations referred to in paragraphs 5 and 6.

These plantations were undertaken in a small forest close to the Nandgaon Station on the G. I. P. Railway, 17 miles east of Manmad junction, and in a forest of the Yeola Range 9 miles south of the same junction; the Nandgaon plantation was done *departmentally* and the Yeola plantation by lessees.

The annual rainfall and maximum and minimum temperature in shade during the last four years are as follows :—

Year.	Plantation.	Rainfall in inches.	Maximum temperature in degrees Fahrenheit.	Minimum temperature in degrees Fahrenheit.
1903	Yeola	25·36	111	48
	Nandgaon	26·34	112	54
1904	Yeola	17·48	110	49
	Nandgaon	14·55	112	54
1905	Yeola	16·42	111	50
	Nandgaon	16·62	112	54
1906	Yeola	15·63	114	53
	Nandgaon	20·3	104	54
Average	Yeola	18·72	111·5	50
	Nandgaon	19·45	110	54

The rainfall is practically all from the western monsoon, the seven months from November to June being almost rainless.

17. In both of these plantations Method II was followed as I did not think of Method I till last year.

18. In the Yeola plantations, the cost to Government has been *nil* since all the work was done by lessees. The tree seeds sown were Melia azadirachta and Hardwickia binata. Now the plants are $3\frac{1}{2}$ years old and some of the former are 7 feet high, and the latter $1\frac{1}{2}$ feet. Though the latter are the smaller, it by no means proves that they are not so successful as this species takes longer to establish itself.

19. The Nandgaon departmental plantation was undertaken in the year 1902 and a part of it is shown in plate 18 *b*. In this plantation I tried strips of Teak, Dalbergia latifolia, Hardwickia binata, Melia azadirachta, Albizzia Lebbek and Acacia arabica.

Plate 18 *b* is taken down an 8 foot agricultural strip on good soil; a Melia azadirachta strip being on the right and an Albizzia Lebbek strip on the left. The growth of the two forestry strips in the plate have met and the cover is already sufficient to kill out most of the grass between them: the seedlings in many of the strips are so dense that they will have to be thinned next June.

Some of the seedlings, considering they are only $3\frac{1}{2}$ years old, have grown extraordinarily well as will be seen from the following measurements of the largest specimen of each species:—

Species.	Girth at breast height. Feet.	Girth at breast height. Inches.	Height in feet.
Teak	0	$6\frac{1}{2}$	15
Melia azadirachta	1	5	16
Albizzia Lebbek	1	$5\frac{1}{2}$	18
Dalbergia latifolia	0	6	12
Acacia arabica	0	11	16

The receipts and expenditure on this plantation show a balance in favour of the former to the extent of Rs. $3\frac{5}{16}$ per acre which is very satisfactory: the cost of supervision is not however included in the calculations, and as the plantation is in a wire fenced forest, close to the Range headquarters, and there is a nursery in it with a man in charge, the supervision and protection was abnormally easy and good.

The agricultural crops sown were sessamum, cotton and the lesser hemp. Whether the nett financial result be a profit or loss depends of course on many things but most of all on the rainfall.

The details of receipts and expenditure are as follows :—

Year.	Expenditure in Rupees on—				Receipts from produce of agricultural crops in rupees.
	Ploughing, harrowing, etc.	Weeding.	Purchase of seed.	Total.	
1902-03 ...	151	75	9	235	280
1903-04 ...	90	64	8	161	202
1904-05 ...	46	16	1	63	30
Total ...	287	155	18	459	512
Per acre ...	$17\frac{5}{16}$	9	$1\frac{1}{8}$	$28\frac{11}{16}$	32

L. S. OSMASTON,

March 1907. *Deputy Conservator of Forests.*

THE STRUGGLE FOR EXISTENCE.

In the "Origin of Species" the following passage occurs :— "*Nothing is easier* than to admit in words the truth of the universal struggle for life, or more difficult—at least I have found it so—than constantly to bear this conclusion in mind. Yet unless it be thoroughly engrained in the mind, I am convinced that the whole economy of nature, with every fact on distribution, rarity, abundance, extinction and variation will be dimly seen or quite misunderstood." During our course of training we have to deal with types of forests in which the struggle with inferior species is almost entirely avoided, and consequently the principal, or only, factors we have to take into consideration are soil, moisture, light, protection from fire, etc. Our field work in Burma is chiefly carried out when growth in the forest is stationary, when the leaves have fallen and most weeds have died down or been burnt, and the forest appears thinly or incompletely stocked with vegetation. Therefore, even if Darwin has grossly exaggerated, it is possible that we have to a slight extent under-estimated the importance of the struggle for life.

Richness and depth of soil and abundance of moisture are frequently injurious to natural teak. The finest growth of which I have ever heard occurred in the Arakan Division where, so I believe, a teak tree in a plantation attained a girth of eight feet in thirty years.* This magnificent growth must be the direct result of exceedingly rich soil, etc., but the excellence of the soil would appear to be actually injurious to natural teak as none is found in this division. Numerous examples could be given of this. In any division, for instance, natural teak is found to be more numerous on exposed ridges where the soil is dry and poor than in ravines where the soil is richer and deeper. Similarly abundance of light may be a disadvantage. In a taungya plantation teak is densely sown before anything else, but in spite of, or perhaps I should say on account of, the fact that teak is given free access to the light, the seedlings are killed out unless the weeds are carefully and frequently cut back, and natural teak unprotected from weeds could not possibly exist under such circumstances. Similarly protection from fire is frequently a disadvantage. In a typical area where natural teak was exceedingly abundant, protection from fire was proved by statistics to have prevented natural regeneration and to have destroyed existing seedlings. It is, in fact, the action and reaction of the innumerable species found in these forests, one with another, that determines the proportion of each, and it is essential to bear this conclusion constantly in mind.

It follows from what I have said that the abundance of natural teak does not necessarily indicate the most favourable conditions for the individual tree. In fact frequently the contrary. Therefore in making taungya plantations, since all competition with other species is avoided, and since it makes little difference to the cost whether the weeds are overwhelmingly powerful or only slightly more vigorous, it is a mistake to select areas where natural teak is already abundant, especially as some of this is destroyed. They

* A similar and slightly larger girth was measured in the teak plantations in the Chittagong Hill Tracts which averaged 27 - 30 years. Many of the trees were blown down in the great cyclone of October 1897 and the wood when examined proved to be soft, light, of inferior quality.—E. P. STEBBING.

should be selected where the best growth can be obtained, and probably it would have been much more profitable to have taken up large areas for plantations in the Arakan Division and the divisions of the Tenasserim Circle, especially as these are naturally protected from fire and contain no natural teak to be destroyed, and growth would probably have been more satisfactory than in the Pegu Circle where most plantations have been made. This system of cultivation is, however, so I consider, barbarous and unscientific, involving great labour and expense for small results.

The size of our divisions in Burma, even if they are to be somewhat reduced, is so great that we cannot indulge in very intense or elaborate systems of cultivation, and consequently we have to rely almost entirely on natural teak for our yield. The most we can attempt to do is to aid this natural teak, and it is essential to understand the principal factors that influence its growth. Teak has a large range and is found in moist and dry forests and on most soils, and there are in fact few localities in Burma where teak will not grow. One teak tree bears sufficient seed to produce itself several million-fold in a few generations, but even in the richest forests teak seldom forms more than 10 per cent of the growing stock, even excluding bamboos and herbs. The scarcity of teak is not due to lack of food or attacks of predacious enemies, as is the case with animate species, but is merely due to the fact that it is swamped out by the multitude of competitors struggling for the same ground. If therefore by some miracle these competing species could be suddenly exterminated, a pure crop of teak would spring up in nearly every forest in Burma.

These competitors may be divided into three classes—herbs, including all herbaceous plants, grasses, bushes, etc., bamboos and trees. The competition from herbs is the most formidable as it is combined with that of bamboos and trees. Very few teak seedlings struggle successfully, and only a minute proportion survive to establish themselves against herbs, and I do not think much can be done to alleviate the struggle for existence at this stage. A teak seedling could not establish itself against herbs if at the same time the shade from bamboos and trees were great. In most

cases the canopy is opened out to some extent (by the fall of a big tree for example), and sufficient light and heat is let in on to the ground for teak to germinate, but insufficient to induce a vigorous growth of herbs. Some of the teak seedlings are thus enabled to establish themselves against herbs, but in the meantime the neighbouring bamboos have also benefited by the light, and growth is stimulated so that the canopy is gradually closed up again and the teak seedlings suppressed. I have often heard it said that it is useless to cut back bamboos in favour of teak, as the bamboo springs up again so vigorously and rapidly, but if the bamboo is cut flush with the ground I have found, as the result of actual experiment, that growth is so weakened that a well-developed teak sapling *can* establish itself against the bamboo. The same thing may be seen in areas heavily worked for bamboo, as teak saplings are noticeably numerous, although the cutting of the bamboos is comparatively light and unscientific and not done to favour the teak. Again, many teak saplings, after establishing themselves against herbs and bamboos, are overshadowed and suppressed by inferior species of trees before they reach maturity. Such teak trees are usually too small to be worth extracting, and if killed are rendered practically valueless. The cost of girdling, or felling, a worthless tree over-shadowing a teak tree is at most one rupee, and the teak tree thus freed would be enabled to attain maturity and of a value of at least thirty rupees as it stands. This work yields therefore a high percentage of profit. Similarly it is not expensive to cut back bamboos in the immediate vicinity of a suppressed teak sapling which would otherwise be killed and rendered entirely valueless.

Of well-developed teak saplings I do not think more than one out of forty ever attains maturity, the remaining thirty-nine being killed by bamboos and worthless trees; but if the proportion of survivors could be increased to two out of forty, the outturn of mature teak would be doubled in less than one generation. This sounds beyond the dreams of avarice, but I not only think it possible but believe very much more could be done at a very small expense. In Europe during the first few years of its life a

tree receives constant attention, and subsequently every ten years more or less help is given, whereas here our outturn consists entirely of naturally-grown teak, of trees that have struggled successfully against all competitors and, without any aid whatsoever, have attained marketable dimensions. Of the enormous number that do die I believe a large number could be saved by a few annas worth of help at a critical period, and it would still yield a handsome percentage of profit were fifteen rupees spent on a teak seedling or tree that would otherwise be suppressed, provided it could thus be ensured to reach maturity.

It is true that we do spend some money on "improvement fellings," but the total amount is very small, and these works are confined almost exclusively to fire-protected areas. Now fire-protection stimulates all growth, not only trees but also bamboos and herbs, and when improvement fellings are carried out, the most that is attempted to be done is to thin out inferior species of trees. These works therefore are insufficient to counteract the effects of fire-protection, a fact clearly proved by the statistics given by Mr. Troup.

A study of the effects of the struggle for existence elicits the fact that the growing stock of teak is "normal"; that is to say, it consists of a uniform series of age and girth gradations from the seedling to the mature tree, which produce annually an equal number of mature trees. The forests could not have been gone over every year but reserves could have been grouped together into convenient working circles, and the whole could have been gone over every thirty years, when equal periodic yields would have been obtained. In virgin forests where a surplus occurs this could have been taken out gradually by raising the minimum girth limit to eight feet for the first period, seven feet six inches for the second period, and seven feet for third and subsequent periods. The only difficulty would have been to have obtained annual coupes that would have yielded approximately equal instalments of the yield, but this could have been done in a rough and ready manner, sufficiently accurately for all practical purposes. A simple and perfectly safe method of exploitation

could thus have been devised by which the greatest possible yield would have been obtained, while at the same time the productiveness of the growing stock would have been kept intact. This would have given very much more satisfactory results than the unsystematic methods of exploitation actually employed, in which uniformity of the annual yield for short periods has been obtained at the expense of every sylvicultural and economic consideration.

The presence of certain species of bamboos, such as *Bambusa polymorpha*, is frequently supposed to indicate a soil extremely suitable for teak. This supposition is, I think, open to great doubt. I think still more excellent soils for teak could be found, but in these cases the growth of inferior species, and in particular shade-bearing species, is stimulated to a greater extent than teak, so that teak is unable to compete with them. Even in the best teak and bamboo forest, when the bamboo is temporarily cleared away, a dense growth of grasses and quick growing stuff springs up with which teak cannot compete. Therefore I think it possible that the abundance of teak in bamboo forests is due, not so much to the excellence of the soil, but to the fact that most species of bamboos are extremely useful associates of teak, in that they keep down species with which teak is unable to compete and at the same time allow a considerable quantity of teak to spring up. Therefore if bamboo were to be eradicated, as is, I believe, sometimes considered desirable, teak would, I think, disappear from many forests.

We are, I think, apt to attribute far too much importance to the direct action of agencies, such as soil, moisture, light, fire, climate, etc. For instance we attribute, without thinking, the marked transitions of growth found at different altitudes to the effect of temperature. This is to a great extent a false view. As the temperature becomes more and more uncongenial to one species it becomes more congenial to other species, and as a very small handicap is of vital importance in the struggle for existence, a species disappears long before it reaches the limit at which it would be killed by temperature alone. Consider the conditions in a spot where any species is most abundant. The soil,

moisture, etc., may be the most perfect obtainable for this particular species, producing growth more vigorous, relative to that of other species than under any other combination of circumstances ; but species are so numerous that many of them must necessarily be similar in their partiality for the same conditions, so that even under the most perfect conditions the struggle is keen. Let the conditions be slightly less favourable and the chances of its enduring the struggle successfully become more and more remote, as the plant comes into fresh competition with other species for which this particular combination of conditions is the most favourable that can be obtained. Thus very great differences in the vegetation may be caused by a very slight difference in the conditions.

I am convinced that by carefully studying the manner in which the various species react on one another, we should acquire considerable knowledge of the best and cheapest methods of assisting by artificial means any given species, such as teak, against its competitors and thus enormously increase its numbers.

TAW THA.

REPORT ON TAPPING OF FICUS ELASTICA AT MUKKIE IN KANOTH RANGE, NORTH MALABAR DISTRICT.

There are six large trees at Mukkie, four medium-sized trees, and three quite young (probably three years old). There is no record as to the actual age of the trees, but from information I have seen recorded I should judge the age of the oldest trees to be 13 or 14 years. They are straggly in appearance, much hacked about to obtain cuttings, and with branches starting either from or close to the ground.

2. Four of the big trees were selected for tapping and were tapped on the 18th and 19th January 1907 on cold misty mornings.

The flow of latex was surprising. The falling latex was collected as far as possible in enamel bowls, the balance being collected in tins and by scrap. With the latex of tree No. 4, a

spoonful of vinegar was mixed. Coagulation was very much delayed especially in the case of tree No. 1 which has taken 42 days to coagulate. The biscuit has turned black but is wonderfully pure and free from smell. Tapping was done with the gouge and mallet and in very few instances was the cambium damaged.

3. The result of tapping was as follows :—

Tree No. 1.-	Biscuit	... 22	tolas	5 branches tapped.
	Scrap	.. 32	do.	
	Trees	... 2	do.	63 tolas.
	Proportion of mat ..	7	do.	
Tree No. 2.-	Biscuit	... 19½	tolas	5 branches tapped.
	Scrap	... 24¾	do.	
	Tree	... 1¾	do.	52 tolas.
	Proportion of mat...	6	do.	
Tree No. 3.—	Biscuit	... 22½	tolas	5 branches tapped,
	Scrap	... 33	do.	
	Tree	... 2¼	do	64¾ tolas.
	Proportion of mat...	7	do.	
Tree No. 4.—	Biscuit	... 14	tolas	7 branches tapped.
	Scrap	... 37½	do.	
	Tree	... 2	do.	60½ tolas.
	Proportion of mat...	7	do.	

It will be seen that three trees have given over 1½ lbs. of dry rubber and the average of the four amounts to just 1½ lbs.

4. The improvement over the Manantoddy trees, where two big trees yielded respectively 48 tolas and 28 tolas of dry rubber, is undoubtedly due to better tapping, and I now consider we should have obtained at least 3 lbs. from the big tree.

P. M. LUSHINGTON,
District Forest Officer,
North Malabar.

EXTRACTS FROM OFFICIAL PAPERS.

DESPATCH No. 22 (FIN.)

We publish the following despatch for the information of our departmental readers.

No. 22 (Financial), dated 8th February 1907.

From the Secretary of State for India (Right Hon'ble John Morley), to the Government of India.

Having considered in Council your letter in the Finance Department No. 455, dated 20th December 1906, I have decided that officers who proceed to this country on combined leave under civil rules shall in future have the option of drawing their privilege leave pay at the Home Treasury. This pay will be converted at the rate of exchange—fixed for the time being for the adjustment of financial transactions between the Imperial and Indian Governments—at present 1*s.* 4*d.* the rupee. Exchange compensation allowance will be added in the case of officers entitled to receive it while in India. The last pay certificates of officers who elect to draw their privilege leave pay in this country should show therefore whether they are entitled to the allowance.

2. In all cases where the rate of privilege leave pay shown in an officer's original last pay certificate requires correction, an amended certificate should be sent to this office, irrespective of the length of his combined leave, unless he is known to have started on his return to India. If the amended certificate arrives too late for action to be taken here, it will be returned to the issuing officer in India.

3. The rules governing the issue of privilege leave pay should be amended accordingly.

4. I concur in the view of your Government that there is no necessity for altering the rules with regard to officers who take privilege leave by itself.

SCIENTIFIC PAPERS.

NOTE ON THE INTRODUCTION AND ACCLIMATISATION OF THE MAHOGANY TREE (*SWIETENIA MAHAGONI*) IN INDIA.

BY M. HILL, A. I. G. OF FORESTS.

Mahogany (from the West Indies) was first introduced into the Calcutta Botanic Garden towards the close of the 18th century and from there was widely distributed over Bengal, and to other parts of India by means of seeds and cuttings. From 1865 onwards consignments of seed from the West Indies became more frequent but were unequal to the demand, until at last arrangements were made for a permanent supply.

The results of the experimental cultivation of this species are briefly as follows :—

Bengal.—In the Royal Botanic Gardens, Calcutta, Mahogany trees have been grown with great and unvarying success since their introduction over a century ago. Before the cyclone of 1864 devastated the Garden, there were hundreds of trees of which 69 were of large size. Very many of the large ones were blown over during the cyclone and their timber fetched the ordinary market price of good Mahogany.

At the present time there are over 200 trees in the Garden, all in a very healthy condition. The largest amongst them measures 120 to 130 feet in height with a girth of 14 to 18 feet measured at 5 feet from the ground. They are handsome trees with straight smooth trunks and would yield fine timber.

There are also some hundreds of young trees in excellent condition in the nursery.

Although Mahogany is liable to insect attacks, it is not more so than other species, and, when grown under reasonable conditions, the damage done is infinitesimal. The mature trees yield seed every year, though not in sufficient quantities to meet the demand for it. Both the country seed and that imported from the West Indies germinate without difficulty and no special precautions are necessary. Approximately 90 per cent of the seed germinate.

On the Grand Trunk Road near Barrackpore and in Barrackpore Park are some fine trees which yearly yield seed of excellent quality. There are also some trees on the Calcutta Maidan, though these are not so fine as those at Barrackpore.

A few trees in the Palamau Forest Division are growing moderately well.

In the Raj Gardens at Durbhanga there are about a thousand Mahogany trees, 20 to 25 years old, planted 10 feet apart in groups and in avenues ; they are all sound and healthy and do not suffer from insect attacks, and though, on occasion, they have been subjected to prolonged inundation no apparent injury has been caused.

Central Provinces.—In the Moharli Garden in the North Chanda Forest Division there are 7 Mahogany trees alive, height 30 to 45 feet and girth about 2 to 5 feet, they are not however particularly well grown trees. There is a small avenue in the Maharaj Bagh; the trees are 28 to 30 years old and average 45 feet in height, but they appear to have been neglected in the past and allowed to grow bushy. In the Telankheri forest 8 trees still survive; one, which has grown up among other trees, is 55 feet high and nearly 4 feet in girth.

Punjab.—Seeds of Mahogany were sown in the Changa Manga and Phillour Plantations in 1886, but the experiment was a failure, and no plants survived.

Although no trees of the true Mahogany are growing in the Punjab Gardens, a good specimen of the large leaved *Swietenia macrophylla* is to be found in the Agri-Horticultural Gardens, Lahore.

United Provinces.—Mahogany trees exist in good condition in the Government Gardens at Cawnpore, Allahabad, Lucknow and Saharanpur. At the last mentioned place there are two very fine old trees, one about 70 and the other nearly 100 years old, originally obtained from the Calcutta Botanic Garden.

Assam.—Experiments were made in 1878-79 both with seeds and plants. In 1884-85 a few young trees survived, but all have since died.

Andamans.—Experiments were made in 1898-99. The first consignment of seed received in 1898 failed to germinate. A second consignment in the same year however gave good results and 1,000 seedlings were raised and planted out, but all save 129 died within 12 months and those still surviving are stunted and unhealthy. In 1899 some 1,200 seedlings were planted out in another plantation, but in 1906 only 315 of these remained alive and these averaged 4′ 6″ diameter and were 15′ to 20′ high, but only 39 were in a healthy condition, the rest being in a more or less dying condition in consequence of severe insect attacks.

Burma. Experiments have been made at intervals since 1878 in the Tharrawaddy and Rangoon Forest Divisions with

unsuccessful results. Of the few trees that survive the majority are ill-grown and are never likely to yield good timber.

Madras.—In the Agri-Horticultural Society's Garden at Madras and in other parts of the town there are a fair number of trees of all ages to 70 years and upwards, mostly planted singly but some as avenues. Generally speaking, they are very healthy and the younger ones are making very good progress. The trees of an avenue planted in 1884 have fruited freely and produced fertile seed from which a large stock of young plants was raised without difficulty. The trees themselves in consequence of exposed situation and lack of attention are not very well grown.

In the Southern Forest Circle regular experiments were commenced in 1883-84 but some trees in South Malabar (Nilambur) date back to 1873. Annual consignments of seed have been distributed since 1892 to South Canara, South Malabar, Nilgiris, South Coimbatore, Madura and Tinnevelly.

On the whole, the results obtained have not been very satisfactory: in some cases the climate, or aspect, and the soil appear to have been unsuitable, in others insects have caused great damage.

In the Northern Forest Circle experimental sowings of Mahogany seeds in Godavari, Kurnool, Kistna, and Bellary have been made for several years past, but Kurnool appears to be the only locality where fairly successful results are likely to be obtained.

In the Central Forest Circle experimental sowings were made in Cuddapah, Nellore, North Arcot and Trichinopoly, but save in the alluvial soils of the Trichinopoly Paduzais the results so far obtained are not encouraging.

Bombay.—There are a few trees 30 to 40 years of age in the Bombay Victoria Gardens, and some about 10 years old. The former are 50 to 60 feet high and the latter about 25 feet high. All are in good condition but have not, as yet, fruited.

There are several well grown trees in the Poona Garden; they appear to be very healthy and yield fertile seed freely, although they are probably not more than 30 to 40 years old.

Baroda.—Until recently Mahogany has not been grown to any large extent in Baroda. Some 100 trees were planted singly and in groups of 3 and 5 during the past 12 years and it was found that most success was attained in localities where the soil is of a black glazy nature. In soils where sandy loam prevails the trees do not thrive so well.

About four years ago 4,000 plants were raised from seed, and planted out in large natural groups on waste land of poor quality. Owing to want of water, unfavourable seasons and damage by monkeys only about 1,600 young trees still survive. Their present appearance is promising and, save for some light attacks of insects in a few cases, they appear to be quite healthy.

Provided that good watering is afforded during the first five years Mahogany appears to be a suitable tree to be grown in Gujrat.

Generally speaking, Mahogany seems to require a good soil and rainfall, freedom from overcrowding and overhead shade, and attention whilst young. It appears to thrive best when grown fairly near the sea, and not far above sea level.

ORIGINAL ARTICLES.

THE REPRODUCTION OF SAL FROM SEED.

Towards the end of his article on this subject, which appeared in the *Forester* for April, Mr. Lovegrove states that fire conservancy "has had the opposite to a good effect on sal reproduction" in "the moist, tropical areas at the foot of the hills in Bengal and Assam"; and in discussing possible causes he raises a question whether changes in the condition and composition of the soil, which he supposes has been brought about by successful fire-protection, may not be one of them.

The effect of accepting a supposition of this nature would be to condemn the system of fire conservancy which is in force in the forests to which he refers, and it is on this account desirable, as

direct observations or experiments to prove, or disprove, the supposition would have to be numerous and lengthy, to consider how far it is supported by the present state of the forests and by observations which, though made with other objects, are capable of throwing light on the theory.

My own experience of the forests in question is restricted to those which lie between the eastern boundary of Nepal and the former boundary between Bengal and Assam, that is to say, to the forests of the Darjeeling, Kurseong, Tista, Jalpaiguri and Buxa Divisions. The Government reserved forests which are situated in this tract of country, which has a yearly rainfall of 100 inches to nearly 300 inches include 528 square miles of plains forests and about 180 square miles of hill forest, exclusive of hill forests which are situated above the ordinary limit of sal or in other localities where sal does not occur.

Till within the last 30 to 40 years all of these forests were burnt whenever they were dry enough to burn, that is to say, almost every year in the case of the bulk of the plains forests, and at longer intervals in that of most of the hill forests, and their fire-protection has not been generally successful for more than 20 to 30 years.

Of the plains forests 332 square miles, or 62 per cent mainly consisting of river beds of recent formation and more or less water-logged depressions, contains no sal, and neither the former burning nor the more recent protection can be held to account for its absence. In the hill forests sal is only found on the ridges and warmest slopes, which are probably less than 20 per cent of the total area.

Thus the total of the areas containing sal in the plains and hill forests is about 230 square miles and the density of the sal in this, so-called, sal-producing area varies greatly. For instance whilst about 12,500 acres of plains forest in the Kurseong Division contains 20 trees of 1 foot in diameter and upwards, and 43 trees and poles of 6 inches in diameter and upwards, to the acre, the corresponding figures for about 85,000 acres of plains forest in the Buxa Division are only 10½ trees and 19 trees and poles respectively ;

whilst in the sal-producing area in the hills the density of sal trees and poles is generally less than in the plains forests of the Buxa Division.

Though, as the above figures prove, the present crop of sal trees and poles is generally far from sufficient to completely stock the sal-producing area, there is ample proof that it is a very great improvement on the crop which existed before fire protection was attempted. In other words it is certain that, but for fire-protection, which has saved large numbers of poles and small trees from injury or destruction, and has enabled many seedlings which would otherwise have been killed or kept back to grow into promising poles, small trees and poles would be much less numerous, and much less promising than is actually the case.

Thus, so far as the crop of poles and trees, over 6 inches in diameter, is concerned, fire-protection has been almost entirely beneficial. But it has to be admitted that it has not generally helped on the reproduction of sal to the extent which was anticipated. Though in most places careful search shows that seedlings and saplings of sal are fairly numerous, the great majority of them are suppressed and, failing effective help, must perish. It is now sufficiently evident that, in the open parts of these forests, some of the inferior kinds of trees grow more easily and more rapidly from seed than sal, whilst a number of other kinds of inferior trees and shrubs are much more shade enduring than sal. In these circumstances it cannot be considered surprising that the dense crop of trees which has established itself in consequence of fire-protection usually includes but a moderate proportion of sal, and that in most places where management continues to be restricted to protection, obstacles to the reproduction of this species tend to become greater. In fact it has become certain that management which is restricted to protection must eventually, in most places, result in the formation of an evergreen or other mixed crop containing little or no sal.

Experience gained from coppice fellings which were carried out in the sal-producing areas of the Jalpaiguri Division for about ten years, ending with 1903-04, conclusively proved that the cutting out of the inferior species does not by itself help the reproduction

of sal. For though suppressed sal seedlings were numerous in the Jalpaiguri coupes and the coppice fellings generally led to the germination of large numbers of sal seedlings, the coppice and seedling growth of inferior species and creepers was so luxuriant that nearly all of the sal seedlings were overwhelmed before they could recover from the effects of their previous suppression or properly establish themselves in the soil; and though numbers of the younger seedlings survived for a considerable time under the rapidly formed canopy of the mixed coppice crop, they were converted by its shade into suppressed bushes, incapable of making any effort to force their way through the coppice.

On the other hand, there is ample proof that the cutting out of an inferior kind of tree or of a few inferior trees, here and there, to uncover suppressed sal saplings, is practically useless. For small openings in the canopy do not suffice to enable suppressed sal saplings to recover their vigour, whilst the smallest kind of opening in the canopy is rapidly taken advantage of by creepers and other enemies of the young sal.

In the last two or three years it has been sought to follow up heavy improvement fellings of the inferior species with yearly weedings which it is intended shall be repeated till the young sal is out of danger. So far as experiments of this kind have gone, they have been very successful both in helping suppressed sal seedlings or saplings to recover, and in enabling seedlings which have germinated just before, or just after, the improvement fellings to establish themselves. In fact the growth of the latter has generally been so satisfactory as to afford grounds for a belief that, under protection, the soil, far from having deteriorated, has greatly improved as a seed bed for sal. These seedlings have not died back to their roots in the intervals between the growing seasons and such of them as are now three years old are mostly strong and vigorous plants 9 inches to 18 inches in height.

Experiments of this kind have not yet gone far enough to show for how long the yearly weedings will have to be continued to assure the safety of the young growth of sal. But apparently in the most favourable localities, weeding for three to four years

will answer requirements, whilst in average localities five to six weedings will probably be required. In the most unfavourable spots the number of weedings required to effect any substantial improvement may be large enough to make this method of improving the forests impracticable, and it is possible that in such localities the use of fire as an agent for reducing the luxuriance of the inferior species will be found to pay. But I am afraid that the effecting of improvements with the help of fire will be uncertain, and will in no case be an easy and inexpensive method. The fact that the previous burning of these areas did not result in their becoming better stocked with sal lends support to a belief that something more than burning will be required to enable them to cover themselves up with sal.

Though it is probable that in these last described areas, which are mostly situated in a part of the tract where the rainfall is very heavy, and, though not actually water-logged, are insufficiently drained, excessive damp has been, at least to some extent, a direct obstacle to the reproduction of sal. But, so far as present information goes, in other parts of the sal-producing area it appears to have only been an indirect obstacle, that is to say, it has favoured the reproduction of competitors more than that of sal.

Anyhow I am not aware of any grounds for supposing that protection has anywhere resulted in increasing the dampness of the ground in such a way as to directly enhance previously existing obstacles to the reproduction of sal.

I may add that in writing the above I have made free use of information contained in various working-plans, especially those made by the late Mr. C. C. Hatt, or supplied to me for other purposes by officers who are directly concerned with the management of the forests in question.

DARJEELING: A. L. McINTIRE, I.F.S.
8th June 1907.

FOREST NOMENCLATURE.

The French have a very complete forest nomenclature; and in the case of coppice with standards, the standards of different classes, according to the number of rotations of the coppice they have lived through, are given special names.

Thus a pole newly selected as a standard is termed "*Baliveau*," one that has lived through one station as a "*Baliveau*" becomes a "*Moderne*," after another rotation it is termed "*Ancien*" and after still another "*Bis-ancien*" or "*Vielle écarcé*."

These terms are not however strictly confined to classes of standards of a definite age, as in practice it is often the custom to class by girth measurement; certain definite girths are recognised as corresponding to certain age classes, so that should a particular standard grow at a slower rate than the normal it might well remain in a lower class while really belonging to the next higher, by virtue of its age.

Thus under 40 cm. in girth a standard is recognised as a "*Baliveau*," from 60 cm. to metre as "*Moderne*" and over 1·20 m. as "*Ancien*" Now a "*Moderne*" measuring 60 cm. at the beginning of the rotation might well only attain to 95 cm. at its term. It would then only be classed as still a "*Moderne*" by its girth though actually an "*Ancien*" in age.

Now though hitherto in India we have not needed any definite terms to distinguish these several classes of standards, the time will come before long when precise expressions differentiating the several ages or classes will be highly desirable if not necessary.

To call them first, second, third rotation (or period) standards would be laborious and liable to cause confusion especially when the stems are classed by girth. On referring to Gerschel's "Vocabulaire Forestier" it will be found that "*Baliveau*" is translated "*Teller*"; "*Moderne*" "*Standard of second rotation*"; "*Ancien*" "*Second class standard*"; and "*Bis-ancien*" "*Veteran or first class standard*."

"*Teller*" would seem to be an error and has also the disadvantage of conveying another meaning; it is probably intended to convey the meaning of "*baliveur*;" one who calls out or signals a

"*baliveau*," "*balivage*" being the operation of marking standards. The other terms are unsatisfactory with the exception of *veteran* which, however, I would prefer to apply as the equivalent of "*Ancien*."

There are two somewhat obscure English words applicable to the first two classes. *Staddle* or *Staddler* is given as the equivalent of "*Baliveau*," in Contanseau's "Pocket French Dictionary" and as the "Standard Pronouncing Dictionary" explains "*to staddle*," "*To leave staddles when a wood is cut*."

For "*Moderne*" we have "*Stander*," which the last named Dictionary explains as "*a tree that has stood long*."

The claims of the terms "*first, second, third, etc., classes*" may be advocated, but though eminently satisfactory in some ways, yet there are objections.

Firstly : in India it has become the practice to term the largest girth category as first class, the next second class and so on in inverse order to that applicable to standards in coppice with standards growing stocks where obviously it is essential that the lowest girth or age category be termed the first class.

Secondly : first class, second class, etc., have come to be applied to the quality of the trees.

It would seem therefore that the use of the terms first, second, etc., class, in connection with the overwood of coppice with standards woods might lead to confusion and that a special nomenclature with a single word for each category will before long be required.

I would therefore propose recognition for the following.—

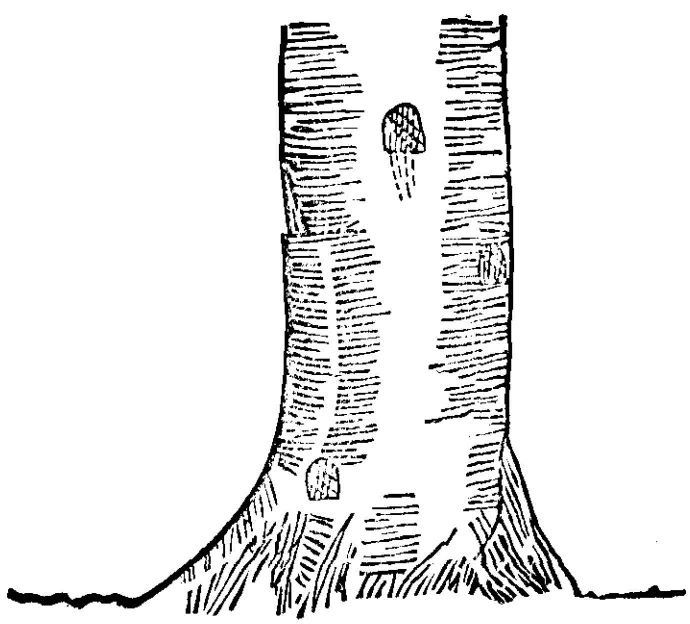
1. (Baliveau) Staddler : a standard when first selected.
2. (Moderne) Stander : during the next coppice rotation.
3. (Ancien) Veteran : three times the age of the coppice it stands over.
4. (Bis-ancien) Ancient : four times the age of the coppice it stands over.

This is a mere suggestion and criticism and suggestions for better terms would be welcome.

DEOTA, 13*th June* 1907. C. E. C. FISCHER.

SOME FACTS ABOUT DAMAR COLLECTION.

It is interesting to note that according to Watt's Dictionary of Economic Products, it is stated that East Indian damar, also known as "Singapore or white" damar, is the true damar and is obtained from species "Damar orientalis." This is a kind of pine with broad needles, the Amboyna pine, known locally as "damar minyak" among Malays, and found growing at heights of 2,000 feet and over—*e.g.*, on Penang Hill and on the main ranges. This may be true of Borneo, Sumatra and Java; but as far as the Federated Malay States are concerned, no damar is collected from this tree.



Damars as collected in this country are obtained from trees of the large natural order *Dipterocorpeæ*: the best from penak (*Balanocarpus maximus*), kijai (*Trigonachlamys*), merawan (*Hopea sp.*), also from *Hopea globasa*; inferior kinds from meranti (*Shorea*), kumus (a species of *Shorea*), and a few others. Besides these there are a variety of damars, such as rengkong, daging, etc., which I will not discuss here.

Doubts seems to exist as to what is the real damar mata kuching, but it may be taken for practical and trade purposes to mean the best pale yellow clear damars, the bulk of which are collected from penak, known as *chengal* in Perak and Selangor.

The trade in this product is far larger in Kuala Pilah district of the Negri Sembilan than anywhere else in the Federated Malay States, and the Malays in this district appear to understand the economic tapping of the trees, while doing the minimum of damage to the tree.

The following is the method of tapping in vogue. Cuts are made about 3 in. wide by 4 in. in height deepening at the lower edge to about 1 in. in depth, but in any case just extending through the bark and exposing the wood, in shape thus—see previous page for illustration.

This cut is then left for about six weeks to two months when the damar is collected. The damar exudes in the form of a soft yellow gum and takes a considerable time to harden. If collected before dry and set, injury is caused to the wound and the damar collected is inferior.

The damar being collected after about two months, the cuts are broadened and lengthened by a second slice being cut, but not materially deepened, the wood merely being scraped, this going on till the cuts are about 6 in. by 7 in. The number of cuts in the tree varies according to size. A tree of 5 ft. in girth is about the smallest that should be tapped and would have five cuts on the stem, all below a height of 6 ft. or 7 ft. and on the buttresses preferred. There would also be three or four on each large branch. As the tree gets larger more taps are made, a tree of 8 ft. or 10 ft. in girth having about 10 cuts and each branch three to seven cuts. When the cuts cease to yield damar they are abandoned and new ones made.

A large tree will yield about 1 to 2 pikuls per annum (1 pikul equals 133 lbs.)

In Pahang the only tapping of which there is any record is that done on Raja Impeh's land at Sempan. The practice in this case has been to make 20 to 80 cuts on the stem, the size of tree tapped varying from 3 ft. to 15 ft. in girth. No tapping was done

on the branches, but the tree tapped up to a height of about 8ft. on the stem. The distances between the cut varied from 2 in. to 12 in., a very insufficient allowance. The size of cuts varied from 8 in. to 18 in. vertically and 10 in. to 12 in. horizontally.

The exudation of damar appears to increase with successive removal of the damar and enlargement of the cuts, done in this case every three months. It was noticed that with this method of tapping the twigs and branches of smaller trees appeared to be dying off.

Damage done.—In Negri Sembilan the cuts being made low down on the trunk, chiefly on the buttresses or on the branches at a great height, the main trunk of the tree remains uninjured. The wounds near the base usually heal up well, and disease does not appear to be introduced through the tapping. The only question is whether the growth of the tree is retarded, or the quality of the timber altered by tapping. The concensus of native opinion will, I believe, be found to negative either of these suggestions.

The present regulations do not allow of trees under 7 ft. in girth being tapped, but if carried on the way described in these notes, it would seem that the minimum girth limit might be lowered considerably. In some parts of the F.M.S.—*e.g.*, in Pahang and Kinta—the Malays are not so careful, and have in some instances done considerable damage to the trees; but this is not in reality a very difficult matter to control, especially if the operations be confined to reserved forests under the control of the Forest Department.

Prices.—First quality damar fetches about $23 per pikul in Penang, and it is evident that if a large tree will yield one pikul annually then the damar industry is one which would in the long run pay as well as timber. The tonnage of a tree of 8 ft. in girth may be taken at 6 to 8 tons, valued at about $50 per ton $300 to 400, but to produce a tree of this size probably 150 to 200 years' growth are required.

If we get in damar an annual income of $20 per tree or nearly 6 per cent., it would appear that the extraction of damar would pay better than the felling of trees.

The following may be taken as a rough estimate of the cost of extraction and the prices obtained, etc. :—

Cost of collection per pikul, best quality	...	$10·00
Government royalty ...	...	2·00
Export duty ($2 to $2·30) say ...	...	2·00
Expenses on cleaning and sorting	...	·50
Transport, shipping charges, etc., to Penang...		1·25
Bags	...	·25
Total	...	$16·00

Average selling price of first quality in Penang $20 to $22.

Samples of nine damars were submitted by me to the Imperial Institute in 1905 and were submitted to commercial experts for valuation, with the result that the best damar mata kuching was valued at 70*s.* per cwt., ordinary damar mata kuching and penak at 55*s.* to 60*s.* The freight, landing charges and commission if sent home to England are very heavy.

The average price obtained on all qualities only come to about $18 per pikul in Singapore or Penang.

Up to within a few years of present date the trade in the Negri Sembilan was in the hands of Chinese, who employed Malay and Sakai collectors. The collectors were supplied with food, stores, clothing, etc., by the Chinaman, who kept an account. When payment was insisted on they collected damar and brought it to him, he fixing the value and crediting their accounts. It is not known exactly what the collectors received, but the result was probably a large profit to the Chinaman through the supply of goods, etc. They would probably receive only 3 to 5 cent a catty or in the case of Sakais even less.

A system has been produced in Kaula Pilah establishing Malay buyers in all parts of the district, who buy damar with money advanced to them, receiving 50 cents a pikul commission, while collectors are paid not less than 7 cents a catty in the most remote parts and as much as 8 or 8½ cents nearer to Kuala Pilah, the cost of cartage falling on the buyer.

A. M. BURN-MURDOCH.

CEPHALOSTACHYUM PERGRACILE IN FLOWER (*TINWA*).

While girdling during the past season, I found Cephalos-tachyum pergracile (Burm. *tinwa*) in flower over a large area.

The area may be said to be roughly 20 miles broad from north to south, and includes all of the Gwethe and Kabaung Reserves in this Division, as well as parts of contiguous reserves. When it is mentioned that the Kabaung Reserve alone has an area of 295 square miles it will be seen that this flowering is rather a big affair.

This bamboo is rather given to gregarious flowering on a small scale, but usually the area is only a few acres; so the present occurrence is on a much more extensive scale than usual.

Though the frequent small gregarious flowering, only extending to an acre or two, might perhaps be properly called sporadic in comparison to the present occurrence, they are not so truly sporadic as is usually the case with Dendrocalamus strictus of which a few clumps are generally to be seen in flower every year wherever it occurs.

The curious thing about the present flowering of the *tinwa* is that even quite young growth of this bamboo is in flower. In the casual glance one takes at bamboos while girdling, I had come to the conclusion that quite a large quantity of young bamboo, aged about four years, was in flower.

On closer examination this was found to be a little misleading. When plants were dug up, it was seen that there were two ages present, both quite young and immature, which is the chief point.

One kind must have been three to six years old while the other must have been ten years old or so. The culms of this latter kind (about $\frac{1}{3}$rd inches thick) had somehow died, and only their bases (3 to 4 inches long) remained on the rhizomes. From the dormant buds on these bases, numerous 5-foot shoots had come up, and flowered, and thus looked much the same as the younger growth, though really the plants were older. Neither kind could by any stretch of imagination be said to be springing from rhizomes in any way mature.

Other young growth, still older (about 12 years) was seen at its normal height (about 15 feet). Most of this also was in flower.

While there was scarcely an exception to the flowering of the mature culms, or of the culms on mature rhizomes, if there was one at all, there were, on the contrary, conspicuous exceptions to the general flowering of the young growth, though these exceptions would not have covered more than 10 acres at a time.

In one case, for no apparent reason, young growth of the two short kinds was in flower, mixed on the upper half of a spur, and in leaf but with no signs of flowering on the lower half of the same spur. Of the 15-foot growth the same can be said high up on one ridge which was more open and exposed than usual. It was not in flower, while lower down on the same ridge it was.

The area on which I saw *young* growth in flower must have extended to roughly 15,000 acres, and the Ranger tells me that the same occurs all over this reserve, wherever there is any young growth of this bamboo.

Some seed has been collected, but the Karens say that owing to the collection having been left too late, *viz.*, May, it is hard to find, as pheasants, jungle fowl, parrots and doves, to say nothing of four-footed animals, have eaten it all up. Some 4½ baskets have been obtained and it seems fairly good seed. Little of this was found on the ground, however, most being rubbed by hand out of the infructescences still hanging on the bamboo.

It is curious how jungle fowl and pheasants swarm this year where last year they were scarcely to be heard or seen, but then there is any quantity of *tinwa* seed this year.

Toungoo, Lower Burma. E. V. ELLIS.

THE EVERGREEN FORESTS OF THE MANJARABAD FOREST RANGE, MYSORE STATE.

These lie along the western and southern boundaries of the range, and border on to the south Canara district and Coorg. They are, *in* fact, so much of the mighty Western Ghauts as is comprised

within the Taluk; and the forests, like those in the adjoining British territory, are evergreen. As for the growth, it is so complete, and the leaf canopy so dense, that the small patches of filtered sunshine which one finds here and there, are of a pale sickly colourlike twilight, or that kind of pale yellow light which follows an afternoon shower. But though the slopes and ravines ("sholas") are so intensely well wooded, the tops of the hills are absolutely bald of tree-growth, but are well clothed with a coarse kind of grass known as "Badai Nulla" and a kind of small Date (*Phoenix rupicola*), the leaves of which are much used by the poor for thatching. These high solitudes are the home of the Sambar and are sealed books to all except the wild huntsmen, who, in their annual irruptions in quest of game, set fire to the grass and afford the Forest Officer a grand spectacle. But these acts of incendiarism are perfectly harmless on account of the evergreen nature of the forests. On these bare peaks one may be always sure of finding the cairn and the circle of the G. T. S. and, as often as not, one may even find a tiny shrine composed of three upright stone slabs, each about 1 foot square, with another one placed on top of them to serve for the roof, while inside this miniature structure will be found rusty copper pieces and small tridents made either of iron or silver. I found one of these diminutive temples on the top of Hebbegiri, and observing a three pie piece in it, I told my Forest Guard to take it. But he covered his mouth, gazed at me with horror, and then whispered that, if he only so much as attempted to touch that coin, the local diety ("Deva" he called it) would rush out of the forest in the form of a tiger and pounce upon and tear us to pieces. I asked Thimmah if I might deposit something with safety; and on his replying in the affirmative, I left the "Deva" a loaded ball cartridge. Thimmah did not approve of this offering, but at the same time advised me not to reappropriate it for fear of that awful tiger. He explained that the tridents were the thank-offerings of people whose prayers had been granted by the return to health of themselves, or of sick relatives, or of sick cattle; but he was not able to explain just why the trident should have been selected. Observing that Thimmah continued to be very anxious

all the while I stood before that harmless little shrine, I suggested a move, and he darted off in advance to show the way.

The trees of the evergreen forests are all giants, and clean, straight stems of 100 to 150 feet are not uncommon. One wonders how they maintain their centre of gravity on such steep slopes, but the absence of breeze might explain it. In the rainy season, however, when the soil becomes quite soppy, one hears the awful crash, crash, crash of falling trees; and an inspection during the ensuing working season will reveal prostrate goliaths every here and there. Inside the forests the atmosphere is stuffy and oppressive, while the stenches are as various as they are offensive.

The following are a few of the kinds of trees which are found in the evergreen forests of this range :—

Dillenia indica ; Michelia Champaca ; Garcinia Cambogia (the fruit of which is used by the people in place of tamarind) ; *Calophyllum inophyllum* and *C. tomentosum* (the former is used in Negapatam, and the latter in South Canara, for boat building) ; *Mesua ferrea ; Pœciloneuron indicum* and *P. pauciflorum* (much valued for walking-sticks) ; *Hopea parviflora* (iron wood) ; *Vateria indica* (the "white Lammar" tree) ; *Diospyros Ebenum ; Cedrela Toona ; Artocarpus hirsuta ; Acacia stipulata ; Lagerstrœmia lanceolata ; Cinnamomum iners,* and *Caryota urens* which the "Malnad" ryot values above every other tree since it affords him his toddy, without which, he will tell you, he would die. Rattan too abounds; and a particular variety known as "naga betta" is esteemed throughout the whole of the State for its talismanic virtues. It is believed that the cobra ("nagra navir," in Caneese) entertains a very great aversion to the cane, and will always avoid it, thus ensuring the safety of the possessor and his household. I doubt if this "naga betta" is found in any other part of India, barring South Canara, and, perhaps, Coorg. The culms are splotched with dark sepia (due to some fungus, I think), while the rest of the surface is of a yellow or ochre colour.

It will be seen from the above imperfect list of trees, that the Mysore State has a mint of money in its evergreen forests; but,

unfortunately, the difficulties of extraction are so great that it is questionable whether it would pay to conduct fellings on a large scale. But since a few years ago the accessible portions are being worked only for certain kinds of timber, such as *Ebony*, *Hopea parviflora*, *Cedrela Toona*, and *Artocarpus hirsuta*; and the produce is all supplied to Mr. Hajee Sait, a large timber merchant of Bangalore.

One would expect that in this mighty mass of vegetation, there should be all manner of animals, every imaginable kind of bird and butterfly, and the most gaudily coloured flowers. But no; for, except the Sambar which has made the bare tops his abode, the elephant, which frequents the deep valleys, and the bear, which hides himself in the heart of the jungle, one may tramp for a whole week and see nothing. The absolute want of grass inside the forests must account for the absence of the deer, the bison, and other graminivorous animals: and it would be a foolish tiger or panther which took up its residence in such a foodless locality. The avifauna too is poor, or so I found it; and excepting the cherry ("Sultan") bulbul (*Otocompsa fuscicaudata*); the "Idle school-boy" (whom I could never see, since he does all his practising far away inside the forest); the noisy golden-backed wood pecker (*Chrysocolaptes gutticristatus*), and a large kind of hawk which utters a scream every now and then, there are few other birds. *Corvus splendens* is far too civilized a bird to live in these wild solitudes; and even the Indian Corby ceases from troubling. As for the butterflies, they are of the poorest kinds—yellow, white, orange-yellow, black-and-white, and a few other sombre coloured ones. But if the birds and butterflies are a poor show, what shall be said of the flowers? Alas! the giants of the evergreen zone produce small, insignificant, inconspicuous, and, for the most part, scentless flowers. The *Mesua ferrea*, however, is an exception. There is no blaze of colour, as no one sees in the "maidan" forests. Nature spent her bright colours to beautify the habitable parts of her earth and then emptied her greens on the lovely regions. But what a variety of greens! and also so soothing to the eye. Bright colours would be here altogether out

of place and betray a downright low taste. All around the little "Inspection lodge" at Remphole and Bisle there is this ocean of variegated green, and gazing at it makes one feel good. Cowper, perhaps, had such a scene before his mind's eye when he prayed :

Oh for a ledge in some vast wilderness,
Some boundless contiguity of shade,
Where rumour of oppression and of wrong may never reach me more.

And Milton when he exclaimed :

"These are thy glorious works, Parent of good !
Almighty, this they universal frame."

SAKLASPUR : D. V. ENERS.
Hassan District, Mysore State.

SILK-WORM REARING IN KOLLEGAL.

In 1798 when Mr. Buchanan travelled through parts of Kollegal, Mysore and Coorg, he did not observe any mulberry cultivation in Kollegal Taluk. The absence of any information of the kind in his book on travels published in 1897 is conspicuous, as he mentions the existence of mulberry cultivation in Mysore. It seems then that the mulberry was introduced to Kollegal Taluk from Mysore Province which adjoins it. This according to information available is said to have taken place in 1824 or 1825.

2. About the year 1883, there were 300 acres under mulberry cultivation in this Taluk, while in 1904-05 an extent of about 8,500 acres was under cultivation. The gradual and steady increase of mulberry cultivation shows that the industry of rearing silk-worms is engaging the attention of the public, and further indicates that there is still a stimulus to increase the prosperity of this industry otherwise languishing owing to extraneous causes such as plague, poverty, etc.

3. It is needless to say that the rearing of silk-worms entirely depends on mulberry cultivation.

4. *Mulberry plants.*—This species, *morus indica*, is propagated by cuttings. These are transplanted in fields in lines 3′ by 2′ and caused to grow bushy and thick by frequent prunings, so as to yield a large quantity of leaves. An area is kept under this cultivation from three to ten years by annual manuring and frequent watering (when the monsoon rains fail) and then abandoned as the soil is found to be much deteriorated. The rearing of silk-worms on the mulberry branches or plants in the fields is not practised for fear of damage by rain, wind, insects, etc., and so these are reared under shelters. The initial outlay per acre on mulberry plants in Kollegal Taluk is about Rs. 7, necessary implements, maintenance of bullocks, etc., being excluded.

5. It is not absolutely necessary for anyone wishing to rear silk-worms to cultivate mulberry himself, nor is it always the case that all raising mulberry crops rear silk-worms also. Some dispose of the leaves at the rate of 8 annas to Re. 1-8 a maund of 25 lbs., or lease out the whole crop of the year for Rs. 40 to Rs. 50 per acre. To rear silk-worms, one has to obtain good "*Seed cocoons*" available in the market at Re. 1-8 to Rs. 2 per 1,000.

6. *This cocoon is of an oval shape and contains the* pupa of a silk-moth of the Bombyx type.

These cocoons are generally kept on a bamboo mat and after nine days from the spinning of the cocoon, moths, male and female, emerge. Their antennæ are pectinated, the wings soft, white and feathery. The female moth is distinguished from the male by its large wings, short and stout body and its inactivity. Copulation takes place at once and lasts for six hours; during the next six hours the female lays as many as 200 to 400 eggs, and then she is thrown away as the result of the following copulations are not always fertile. A female lives for about three days.

7. The female moths are made to lay eggs on a circular bamboo plate (*canarese-tattai*) made of split bamboos and the eggs hatch in about ten days if kept free from the attacks of lizards, ants, rats, etc. The egg-shells are then cast away and the caterpillar is transferred to another bamboo plate.

8. Now commences the stage of feeding :—Mulberry leaves are chopped into pieces and spread on the plate. The larva after eating what it requires buries itself under the dèbris. This is a sign that it requires more fresh leaves. Fresh leaves are supplied five times a day and three times during the night.

9. In growing the larva passes through four stages, locally known as "fevers," each stage lasting five days. At the end of a stage, or fever, the larva becomes motionless for a whole day and does not feed. By next day its size has increased and more leaves are required for its feeding. As the larva develops, coarsely cut leaves can be supplied. During each fever, or stage, food is eaten during four days and rest one day.

After passing through the four stages above referred to, the larva takes another seven to ten days to become full grown, and is then called a *fruit larva*. It then has 11 segments and is 2″ long. Segment 1, 2, 3, 6, 7, 8, 9, and 11 contain each a pair of legs. The sizes of the larva at several stages are $\frac{1}{2}''$, 1″, $1\frac{1}{4}''$, $1\frac{3}{4}''$ and 2″ respectively.

10. The fruit or matured larva is then left to wander in a *chandrika*, or spinning screen, 6′ by $3\frac{3}{4}'$ made of split bamboo matting with circular and oval compartments in which the cocoons are spun. Generally about 700 larvæ are placed on each *chandrika*. The sickly ones known as *mattu uzhoo*, and distinguishable by their black colour and slender bodies are thrown away, as they produce no cocoons of any value. These vary from 3 to 5 per cent according to season.

The larvæ wander through the oval-shaped compartments, secreting from glands in the mouth a fluid which, in contact with air, is transformed into a silk thread, visible but minute. The larva takes 48 hours to spin its cocoon. After this the larva passes into the pupa state, in which it remains for nine days, before the moths emerge. Half to 1 per cent of the cocoons are set aside for future breeding purposes and are known as *Seed cocoons*. The time taken from the egg to the reeling is 48 days, six crops of silk being gathered annually, but this number depends on the supply of food and the character of the season. The period from July to

September is considered to be the best season as the larva is then found to spin thick silk, hence the greater quantity of cocoons are reared in this season.

11. The women attend to the rearing of silk-worms and men cut and bring leaves: in this way one family can look after 12 *chandrikas*, or 84,000 larvæ, for which 35 maunds of mulberry leaves are required for feeding them through all stages.

12. The market price of a maund of cocoons is Rs. 10 to Rs. 12, and a maund contains on an average from 12,500 to 13,500 cocoons. If moths have emerged the cocoons are priced very low, *viz.*, at 2 to 3 annas per 1,000 as the silk cannot be easily reeled off, and has to be done by hand.

13. *Reeling.*—As it is difficult to reel silk off the cocoons when the pupa is alive, some precaution is taken to first kill the pupa inside. On the 5th day after the completion of the cocoons, they are removed in a basket and placed over a mud pot of boiling water covered by a gunny bag. The steam is allowed to pass through, and the pupa is thus killed. Cocoons can be kept for so long as three months without being reeled. In any case the silk cannot be reeled without first killing the pupa.

The next thing is to boil the dried cocoons in water at the boiling point. When the cocoons become sufficiently soft, the rough outer coverings are removed by hands as wastage and the inner soft fine threads are wound off the cocooon by hand or with a bamboo needle, eight to nine cocoons going to form a single thread. These threads are passed through four holes in a small iron plate placed by the side of the boiling basin and in front of the reeling machine, in such a way that the cords passing through the holes are passed crosswise round the wheel of the spinning machine. The wheel is turned by a handle slowly at first and cords are wound round the spinning top in four rolls. As soon as all available silk is got out of the cocoons first thrown into the boiling water the waste silk (jote-can) and the dead pupa are removed and fresh cocoons thrown into the basin.

To keep the water always at the boiling point in the basin, there is a furnace below over which the basin is kept. Of course

fuel consumption is great, being 4 maunds for every 20 seers, of 8,000 cocoons, or for 2¼ seers of silk. It should be understood that a man can deal with a seer of cocoons at a time in the basin, or 3 seers, or 1,000 cocoons, in a working day of eight hours.

14. The silk thus reeled off on the loom is classified into three classes according to its texture which depends on the quality of cocoons and on the dexterity of the man working at the reeling machine. Their prices are as follows:—I, Rs. 145 to Rs. 165; II, Rs. 125 to Rs. 140; III, Rs. 90 to Rs. 115 per maund of Rs. 1,000 weight. The quality of the cocoons is gauged from more or less the weight of silk they give.

I class—24 seers of cocoons should give 2¼ seers of silk or...	1 in 11
II class	1 in 13
III class	1 in 15

Doddinduwadi silk is considered to be the best in Kollegal Taluk at present.

15. The waste silk mentioned in para. 13 is also exported to Bombay at a price of Rs. 12 to Rs. 22 a maund, estimated to be 6,000 maunds on an average per annum. The quantity of raw silk exported annually is about 10,000 to 12,000 maunds, the chief places of export being Trichinoply, Salem, Kumbaconum, Madras, Raichur and Bombay; while the quantity imported is about 6,000 maunds annually. Only about 3,000 maunds of local silk is utilised for local manufacture of silk of various patterns and colours.

16. It may interest the readers to know something about the method of dyeing the silk as practised in Kollegal. At present nine different dyes are made use of:—

Vegetable dyes (*a*) ... 1. *Kamela* (*M. philippinensis*), Kapila Ithi (Canarese).

2. *Arnatto* (*Bixa-orellana*) aludhi (Canarese).

3. *Kerumangi.*

4. *Lac* (Araku or laki, Canarese).

Mineral dyes (*b*) ... 1. Green.
2. Violet.
3. Black.
4. Rose.
5. Slate.

17. *Method of dyeing.*—Before describing the method of dyeing it should be stated that the raw silk as reeled on to the loom is somewhat coarse in texture and yellow in colour: this is first sorted by hand (1 seer of sorted raw silk gives ¾ seer sorted twisted silk) and then bleeched.

Bleeching.—A mixture of alkaline mud (chowli Canarese) and 6 tolas of lime is put into 5 seers of cold water, and kept for 4 hours to settle. The watery portion is taken and boiled. One seer of twisted silk is dipped into this boiling solution until it turns white.

After some time the silk is washed and beaten well in cold water, to get rid of the smell, and dried in the shade.

1. *Kamela dyeing.*– Kamela is a powdery substance obtained from the fruit of *Mallotus philippinensis.* This powder is obtained from Mysore at a cost of Rs. 12 to Rs. 15 per maund. It is also available in the Government forests, but so far no steps have been taken to collect it

Six to 8 tolas of Kamela thrown into ⅛th seer of cold water is stirred well with a stick and poured into 2 seers of boiling water to which a tea-spoonful of gingelly oil is added. One seer of white silk is dipped into it till it is dyed to the shade required. The colour becomes fast after smearing the silk with alum water. Then the dyed silk is washed in cold water and dried.

2. *Arnatto.*—Same as above.

3. *Kerumangi.*—Kerumangi, or Cochineal, dye secretions (found on Euphorbia) 1 seer with ¼ seer *Pista* (gall of an insect, probably of acynip) is well powdered and dissolved in 1½ seers of boiling water, one seer of silk is dipped into this and dyed to the shade required.

4. *Lac.* (Araku).—3 seers of lac and 6 seers boiling water are put into a mud pot and stirred till the solution gets the shade

required. Silk smeared with alum or saffron solution (the former gives a light red tint and the latter a deep red tint) is then dipped into lac solution four or five times and allowed to remain in it seven or eight hours. The silk is then washed in cold water and allowed to dry in the shade.

5. *Green.*—One seer of silk is soaked in an alum solution prepared from 2 tolas of alum and ½ seer of water and is dried in the shade. This is dipped four times into a green solution prepared from 4 tolas of green powder and 1 seer hot water, and then kept for eight hours. This is washed in cold water next morning.

6 to 9.—The same as above with the only exception that the corresponding powders are used to get their respective dyes.

18. Kollegal silk is a little rougher, heavier and stronger than that imported from Bombay, and hence is priced higher. The prices of cloths for women with silver embroideries range from Rs. 30 to Rs. 500 and without embroideries Rs. 20 to Rs. 50; while those for men with lace, range from Rs. 20 to Rs. 100 and from Rs. 12 to Rs. 20 without lace. Superior laced cloths for turbans for Hindus cost Rs. 40.

19. In Kollegal Taluk, Kollegal is the seat of manufacture of silk cloths, handkerchiefs of various patterns, etc., and with a few days' notice any pattern can be produced. While Alahally, Kongarally, Kamakerai, Doddinduwadi, Kunavally, Mudigundam, Singa Nellore, and to a slight extent Kannar, Maduvanhally, Thimmarajpuran and Mathipuran are the villages where silk-worms are reared and silk reeled, and from where raw silk and cocoons are brought to Kollegal for sale.

20. It will not be out of place to mention here that great improvements in the silk industry are being introduced in Tata's Experimental Silk Farm at Bangalore, 120 miles distant from Kollegal, by Mr. T. Od Lu, a Japanese expert in charge of the farm. The chief improvement consists in introducing new methods of rearing silk-worms, reeling silk, obtaining good sized cocoons by introducing European varieties, etc.

21. *Expenditure.*—

	Rs.	a.	p.
(*a*) Cost of cultivating, manuring and planting 1 acre of land with mulberry.	8	8	0
(*b*) Subsequent weeding and cultivation ...	4	0	0
(*c*) Rent of 1 acre of land	1	0	0
(*d*) Cost of 500 seed cocoons which will yield sufficient worms for the produce of 1 acre of mulberry land.	1	0	0
Cooly wages for bringing leaves and rearing worms and cocoons (12 *chandrikas*).	15	0	0
Cost of reeling	2	8	0
Cost of fuel	1	4	0
Total Rs. ...	33	4	0

Receipts.—

The worms reared out of 500 seed cocoons should yield 120 seers of cocoons and at the rate of $2\frac{1}{4}$ seers of silk for every 24 seers of cocoons, the cost of 40 seers of silk being Rs. 165 on an average; the value of raw silk produced is Rs. 46-6-6.

Hence net profit is Rs. 13-2-6 for one crop.

KOLLEGAL: K. S. NARAYANA AYANGAR,
4th January 1907. FOREST RANGE OFFICER.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

NOTE ON THE EFFECT OF STRYCHNINE POISON ON WILD DOGS.

SIR,—In the Nimar District of the Central Provinces wild dogs have been exceptionally numerous of late years, doing no end

of damage to game, and so far as my experience goes are becoming daily bolder and more fearless in their relations to human beings.

An attempt is being made to reduce their numbers by arming some of the more reliable forest subordinates with Snider muskets for the destruction of these pests. In this way in the last three years an average of about 20 dogs per annum have been accounted for, but all to no purpose, for the numbers are undoubtedly increasing.

During the month of March this year the dogs began to turn their attention to buffalo "kills" tied up for tiger.

In this way I lost two "kills" within a few days. It then occurred to me I might turn this new feature to good account by keeping by me a supply of strychnine poison. I at once wrote to Messrs. Kemp and Co. of Bombay and obtained a supply of strychnine.

I have not tasted it myself, but I have no reason to suppose it is not what it is intended to be.

I did not have to wait long before a chance arose of using it.

On the 17th April I had a panther kill and on the morning of the 18th, when I arrived at my camp at Chikdaria forest village, I was brought word that three wild dogs were on the kill. I immediately proceeded to the spot in time to see three dogs slinking off into the jungle. On examining the kill I found the head and shoulders of a small "boda" remaining. I thereupon cut gashes about 6 inches long and 2 inches deep in the fleshy parts and inserted into these cuts 11 grains of strychnine. I then left the kill at about 10 A.M. and did not return to it again until 5 P.M. On my return there was not a vestige of the kill remaining, it had been completely eaten up. The next thing to do was to look for dead dogs, but a close search round the kill only produced two dead vultures.

I then moved off towards a tank which contained the only available drinking water for animals for several miles around. I thought I might possibly find some dogs near the water. About a quarter mile from the "kill" and close to the tank I was assailed by a terrible odour and looking about came upon the fresh vomit of a dog,

or dogs, and the next moment saw half a dozen slinking along to the tank to drink. An unsuccessful shot at one of them dispersed them.

In the end I found nothing more and the total result of the 11 grains of strychnine was one wild dog's vomit.

The next morning a better chance came. I was about to march when a noise, which I took to be that of a bear, caused me to run off in the direction it came from, taking my rifle with me. Not 100 yards from my camp I came across a young doe (Nilgai) not yet dead, but already the dogs had began their horrid meal. The sight was gruesome and I quickly despatched the groaning animal.

This was an opportunity not to be missed, a perfectly fresh kill and hardly touched. While sending off for the strychnine I sat up over the kill with my wife who was fortunate in polishing off an old dog which returned in the meantime for a meal.

It is as well to note the size of the kill which was that of an ordinary country tat about 11 hands in height.

I determined to do the work thoroughly this time. I therefore cut long deep gashes all over the body, head, neck, rump, thighs, in fact everywhere where there was plenty of flesh.

This I did on both sides, and into each cut I sprinkled from 4 to 5 grains of strychnine closing up the cut again carefully. In this way I distributed 104 grains of strychnine in 20 to 25 long deep cuts all over the animal. I then left two men in charge with strict orders to watch the kill and not allow any birds or animals to come to it until night time.

I felt sure I was going to bag the whole pack this time. The next morning I was unable to go myself, but the news was brought me that the kill had been eaten up, and the only thing to be found was one dead hyena; I could hardly believe the report. I therefore sent my own shikari to hunt the jungle all round and the following day I myself went to the spot. There was no doubt about the truth of the report, there was not a vestige of the nilgai to be found, not even its hoofs. The dead hyena was within 10 yards of the spot and two or three vultures but nothing else. The jungle for half a mile round was searched, but not

a dead dog was to be found though their vomit was come across.

If those who have waded through this long story so far can explain this phenomenon I shall be extremely grateful.

Obviously the hyena could not have eaten up the whole Nilgai. What happened to the dogs? Did they go off and die in holes far away; or are they immune to poison? Is it possible to give too much poison, if so, what is the correct amount? I cannot find the answer to this riddle.

I throw out a suggestion, not my own; do the survivors carry off their dead and bury them? This is not such an idle question as it may seem. A sportsman shooting in this district this year compared notes with me and told me that he had also tried poison, strychnine and arsenic and had seen one young dog die, whereupon its mother appeared and tried to drag it away.

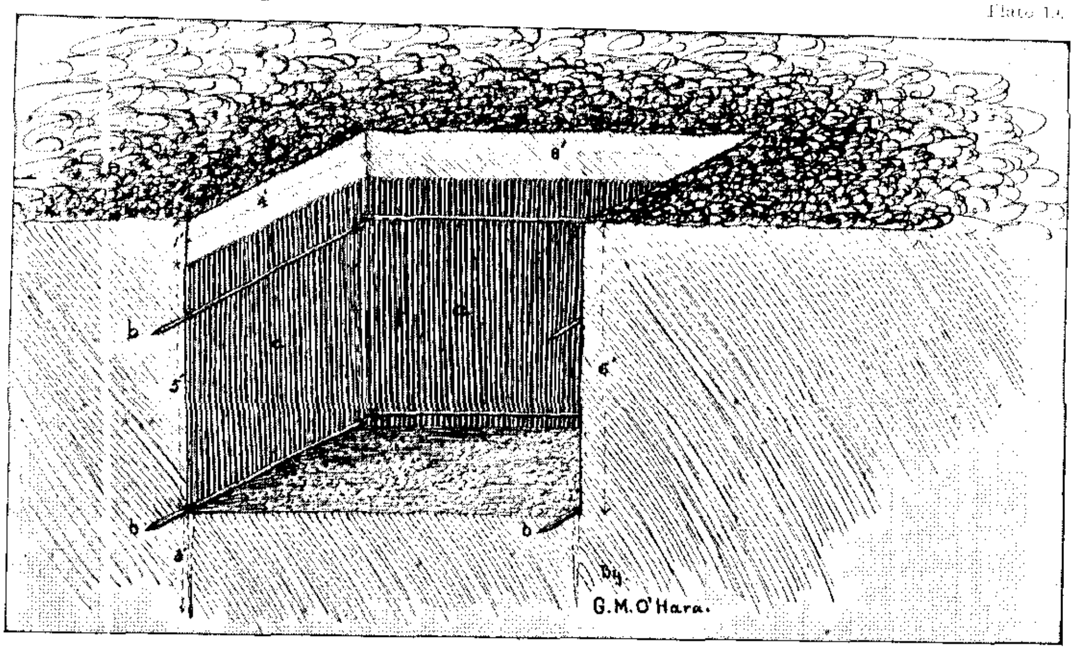
If this story serves to elicit replies from other sportsmen with proved methods of using poison to exterminate wild dogs, the present failures will not have been altogether in vain. The matter is an important one in the interest of sport.

I may add that the dogs in this district are becoming so fearless that only this last month a forest guard was able to kill one with an axe. The brute with several others was actually coming to attack him.

KHANDWA:
20th June 1907.

D. O. WITT,
D. C. Forests.

[NOTE.—We remember to have heard many years ago that large doses of strychnine usually cause vomitting and that the proper dose to kill animals of the size of a dog would be one to two grains, placed in the cuts as described in the above article. We trust that all who have tried to destroy wild dogs will send us their experiences.—HON. ED.]



a. Vertical poles lining the four sides of the Pit,
b. Horizontal poles, the ends of which are inserted into the sides of the Pit.

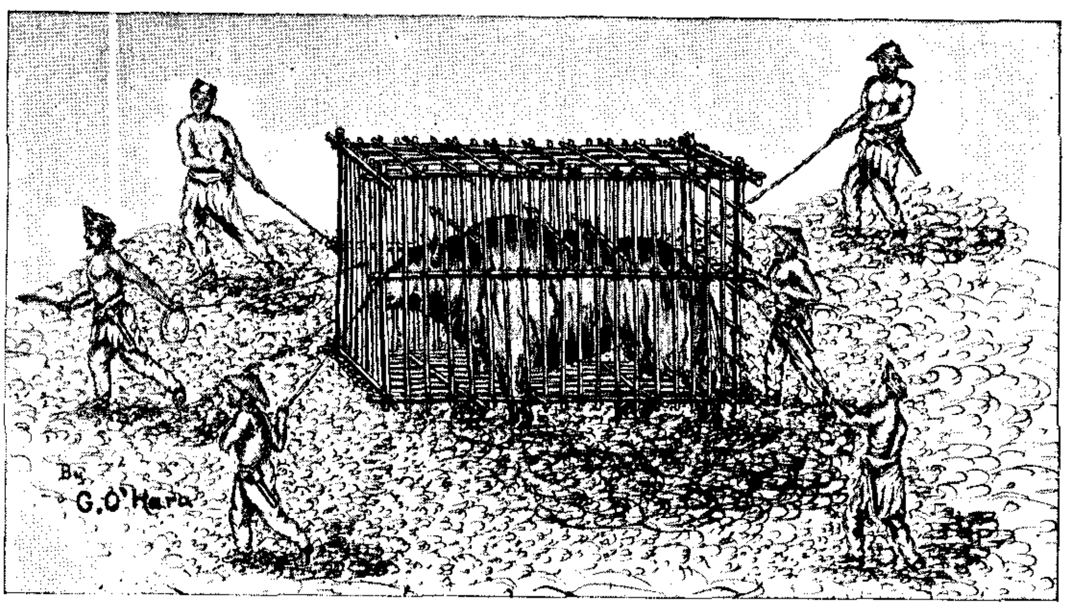


Photo Etching, Roorkee College.

Sketch showing the Rhinoceros carrying its own Cage and being led through the forest by six Malays by means of Rotan attached to the Cage.

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INDIAN FORESTER

AUGUST, 1907.

REVIEW ON THE NEW EDITION OF VOLUME IV OF DR. SCHLICH'S MANUAL OF FORESTRY.

FOREST PROTECTION, BY MR. W. R. FISHER.

(*Contributed.*)

This second edition of Mr. Fisher's work is based on the fourth edition of Dr. Hess's Forstschutz which was published in 1900. It contains something over a hundred additional pages and 41 more plates than existed in the former edition. Most of the additional matter is due to additions made by Dr. Hess in the last edition of his work. Mr. Fisher's book, however, is not merely a translation of the German work, but is adapted to suit the requirements of English and Indian foresters. It now forms a large volume of over 700 pages, of which one-third is devoted to insects.

From the European standpoint, we have nothing but praise to give to this new and improved edition of a standard work which may well serve as a model of exhaustive research, but from our own point of view, namely that of the Indian forester, we

confess that we are of opinion that Mr. Fisher would have done better if he had acted on the friendly suggestions which, in his preface to the new edition, he says he had received, and had written an original work on the subject himself.

The scope of practical application in the woodlands of Great Britain of a book of this kind must necessarily be very restricted, and taking into consideration Mr. Fisher's present occupation at Oxford, it may be fairly assumed that his *principal* object in bringing out the present volume was the education of candidates for the Indian Forest Service. Under these circumstances, an original book, modelled may be on the German work, but written for and about Indian forests and Indian conditions, would, we venture to think, have been more useful.

Forest protection is an essentially practical subject, into which theory enters very little. It is moreover necessarily a rather *local* subject, since the dangers that threaten the well-being of a forest on one side of the globe will very likely be quite different from those which have to be guarded against in forests on the other side. The conditions too which effect such matters as boundaries, forest offences, bad utilisation, etc., are necessarily quite different in India to what they are in England or Germany. It may of course be contended that, taking insects, for instance, as an example, though the specific pest is different, the nature of it remains more or less the same; this is no doubt true to a certain extent, but, all said and done, the practical value of all the preventive and remedial measures to protect forests against insects, advocated in such books, is not very great, and it seems hardly worth while for a student to work through over 200 pages of European insects in a volume, not on Entomology, but on Protection, in order to learn the few common-sense rules which every Indian Forest Officer of ordinary intelligence has no difficulty in grasping and applying.

Again, the result of the three-fold process of translating a German work on Forest Protection, then of adapting it to English requirements, and finally of putting a kind of adventitious Indian complexion on it, is to produce a rather over-long and diffuse

volume. The ground-work is German and refers to German conditions; this is adapted to English requirements by bringing in every here and there the names of English wood-lands, animals and insects; and lastly, to suit the requirements of Indian students, a little paragraph referring to India, often of rather a perfunctory kind, is added under most headings; as, for instance, under Pasture, we are told that in India elephants bark trees with their tusks.

From the point of view of the Indian Forest Officer therefore we should prefer to see an original work on Forest Protection written by an Indian Officer of large experience and knowledge of Indian conditions over the whole empire, instead of an adaptation of an European classic.

ORIGINAL ARTICLES.

HOST PLANTS OF LORANTHACÆ.

During 1906 I made notes as to the host plants of the various species of Loranthus and Viscum seen in the North Coimbatore Division. I had hoped to obtain a more or less complete list, but having now been transferred and there being little chance of my taking further notes in the same locality for some considerable time, I append the list, incomplete as it is.

It will be seen that there are two cases of double parasitism ; of a Viscum on a Loranthus, the latter being again parasitic on some tree.

These parasites of both species are commonest in dry deciduous forests at elevations between 3,500 and 4,500 feet and here one frequently meets patches in which practically every tree (specially Anogeissus latifolia) is attacked. Nevertheless I have never come across a case in which a tree has been absolutely killed by its parasites, though often bearing a number of bushes.

Loranthus longiflorus, var : falcata, is an exception as regards elevation as it is much more common at from 1,000 to 2,000 feet, and there in places nearly every Albizzia amara bears its parasite of that species.

The tree most frequently attacked by each species is entered first in the list ; this, however, does not apply to var : pubescens of L. longiflorus, Viscum novoiceum, V. verruculosum and V capitellatum which were seen only once on each of the hosts entered against them.

Parasite.	*Hosts.*
1. Loranthus intermedius, W.	Machilus macrantha.
2. Loranthus Hookerianus, W. and A.	Mallotus philippinensis
3. Loranthus scurrula, Linn.	Acacia Intsia, Grewia tiliæfolia, Pterocarpus marsupium, Dalbergia latifolia, Dalbergia paniculata, Acacia lucophlea, Cordia McLeodii, Phyllanthus emblica, Ficus bengalensis.
4. Loranthus tomentosus, Heyne.	Phyllanthus emblica and Acacia Intsia, Grewia tiliæfolia, Acacia pennata, Anogeissus latifolia, Premna tomentosa, Elœagnus latifolia, Glochidion velutinum.
5. Loranthus bracteatus, Heyne.	Garuga pinnata every tree of this species in a road avenue for 1 mile was attacked), Melia azadirachta, Ficus Tsiela, Ficus bengalensis, Ficus mysorensis.
6. Loranthus longiflorus, Desrouss Aypica.	Anogeissus latifolia, Shorea Talura, Protium caudatum, Melia Azadirachta, Buchanania latifolia, Careya arborea, Canthium parviflorum.
do. do. var : falcata, Kurz.	Albizzia amara, Melia Azadirachta, Acacia leucophlea.
do. do. var : pubescens.	Eriolæna Stocksii, Albizzia odoratissima.
7. Loranthus loniceroides, Linn.	Anogeissus latifolia, Ficus Benjamina, Myristica sp. Ficus glomerata.

Parasite.	*Hosts.*
8. Loranthus capitellatus, W. and A.	Mangifera indica.
9. Loranthus Sp. (not found in flower and not identified).	Memecylon edule.
10. Viscum monoicum, Roxb.	Wrightia tomentosa, Atalantia monophylla, Pongamia glabra.
11. Viscum verruculosum, W. and A.	Fluggea microcarpa and Eugenia jambolana.
12. Viscum capetellatum, Sm.	Loranthus tomentosus, Loranthus, longiflorus typica (both these parasitic on anogeissus latifolia), Erythroxylon monogynum.
13. Viscum articulatum, Burm.	Grewia tiliæfolia, Zizyphus xylopyra, Dalbergia latifolia, Diospyros tomentosa, Diospyros melanoxylon.

In order to complete the list of local Loranthaceæ I add the following of which the host plants were not noted :—

Loranthus obtusatus, Wall.
Loranthus cuneatus, Heyne
Loranthus longiflorus, Desrouss var : amplexifolia Thwaites.
Loranthus neelgherrensis, W. and A.
Viscum orientale, Wild.
Viscum ramosissimum, Wall.
Viscum angulatum, Heyne.
Viscum articulatum, Burm. var : dichotoma.

DEHRA DUN, C. E. C. FISCHER.
14*th July* 1907.

SUMMARY OF GENERA AND SPECIES DESCRIBED IN THE FLORA OF BRITISH INDIA.

Dr. A. R. Wallace in his book "Darwinism" mentions that the genera and species in Sir J. D. Hooker's Flora of British India

have not been totalled; having some time back drawn up a summary for my own purposes, its publication may prove of interest to others.

In the appended list garden plants which are merely mentioned and not described and all those species entered at the end of the space devoted to each genus "as doubtful and excluded species," etc., have been omitted, but a note on them will close this article. In the list are included 70 non-indigenous cultivated plants which are more or less fully described.

A.—DICOTYLEDONS.

Order.		Genera.	Species.
I.—Ranunculaceæ ...	...	19	115
II.—Dilleniaceæ ...	...	6	44
III.—Magnoliaceæ ...	...	8	27
IV.—Anonaceæ ...	...	26	192
V.—Menispermaceæ	...	19	34
VI.—Berberideæ ...	..	6	17
VII.—Nympheaceæ ...	...	5	8
VIII.—Papaberaceæ ..	...	5	14
IX.—Fumariaceæ ...	...	4	31
X.—Cruciferæ ...	...	43	137
XI.—Capparideæ ...	...	8	53
XII.—Resedaceæ ...	...	3	4
XIII.—Violaceæ ...	...	3	24
XIV.—Bixineæ ...	...	10	26
XV.—Pittosporeæ ...	...	1	9
XVI.—Polygaleæ ...	...	5	34
XVII.—Frankeniaceæ ...	...	1	1
XVIII.—Caryophyllaceæ...	...	19	104
XIX.—Partulaceæ ...	...	2	6
XX.—Tamariscineæ ...	...	2	8
XXI.—Elatineæ ...	...	2	6
XXII.—Hypericineæ ...	...	3	26
XXIII.—Guttiferæ ...	...	6	61
XXIV.—Ternstrœmiaceæ	...	14	53
XXV.—Dipterocarpeæ ...	...	9	92

Order.			Genera.	Species.
XXVI.—Malvaceæ	...	...	27	116
XXVII.—Sterculeaceæ	...	...	17	88
XXVIII.—Tiliaceæ	...	...	13	111
XXIX.—Lineæ	...	...	7	22
XXX.—Malpighiaceæ	...	...	3	13
XXXI.—Zygophylleæ		...	4	8
XXXII.—Geraniaceæ	...	...	10	176
XXXIII.—Rutaceæ	...	...	23	78
XXXIV.—Simarubeæ		...	9	17
XXXV.—Ochnaceæ	...	...	4	11
XXXVI.—Burseraceæ	...	...	10	39
XXXVII.—Meliaceæ	...	...	19	84
XXXVIII.—Chailletiaceæ	...	...	1	6
XXXIX.—Olacineæ	...	...	23	63
XL.—Ilicineæ	...	...	1	24
XLI.—Celastrineæ	...	...	13	105
XLII.—Rhamneæ	...	...	12	51
XLIII.—Ampelideæ	...	...	3	94
XLIV.—Sapindaceæ	...	...	24	71
XLV.—Sabiaceæ	...	...	2	21
XLVI.—Anacardiaceæ	...	...	23	107
XLVII.—Coriariæ	...	...	1	1
XLVIII.—Maringeæ	...	...	1	2
XLIX.—Connaraceæ	...	...	7	35
L.—Leguminoseæ	...	...	132	834
LI.—Rosaceæ	...	...	27	233
LII.—Saxifragaceæ	...	...	14	80
LIII.—Crassulaceæ	..	...	8	40
LIV.—Droseraceæ	...	...	2	4
LV.—Hasumamelideæ		...	8	8
LVI.—Halorageæ	...	...	5	12
LVII.—Rhizophoreæ	...	...	10	21
LVIII.—Combretaceæ	...	...	8	45
LIX.—Myrtaceæ	...	...	12	158
LX.—Melastomaceæ	...	...	21	166

Order.			Genera.	Species.
LXI.—Lythraceæ	...	...	11	45
LXII.—Onagraceæ	...	...	5	21
LXIII.—Samydaceæ	...	...	3	26
LXIV.—Passifloreæ	...	...	3	10
LXV.—Cucurbitaceæ	...	...	29	71
LXVI.—Begoniaceæ	...	...	1	64
LXVII.—Datiscaceæ	...	...	2	2
LXVIII.—Cacteæ	...	...	1	1
LXIX.—Ficoideæ	...	...	7	16
LXX.—Umbelliferæ	...	...	39	156
LXXI.—Araliaceæ	...	...	19	56
LXXII.—Cornaceæ	...	...	7	19
LXXIII.—Caprifoliaceæ	...	...	8	49
LXXIV.—Rubiaceæ	...	...	91	611
LXXV.—Valerianeæ	...	...	4	17
LXXVI.—Dipsaceæ	...	...	4	17
LXXVII.—Compositeæ	...	...	128	605
LXXVIII.—Stylideæ	...	...	1	3
LXXIX.—Goodenovieæ	...	...	1	2
LXXX.—Campanulaceæ	...	...	13	64
LXXXI.—Vacciniaceæ	...	...	4	47
LXXXII.—Ericaceæ	...	...	9	62
LXXXIII.—Monotropeæ	...	...	3	3
LXXXIV.—Epacrideæ	...	...	1	1
LXXXV.—Diapensiaceæ	...	...	1	1
LXXXVI.—Plumbagineæ	...	...	6	9
LXXXVII.—Primulaceæ	...	...	9	80
LXXXVIII.—Myrsineæ	...	...	11	88
LXXXIX.—Sapotaceæ	...	...	8	53
XC.—Ebenaceæ	...	...	2	68
XCI.—Styraceæ	...	...	2	70
XCII.—Oleaceæ	...	...	10	84
XCIII.—Salvadoraceæ	...	...	3	5
XCIV.—Apocynaceæ	...	...	40	132
XCV.—Axlepiadeæ	...	...	53	250

Order.			Genera.	Species.
XCVI.—Loganiaceæ	...	...	8	50
XCVII.—Gentiavaceæ	...	...	15	132
XCVIII.—Polemoniaceæ	...	...	1	1
XCIX.—Hydrophyllaceæ		...	1	1
C.—Boragineæ	...	...	32	140
CI.—Convolvulaceæ	...	...	15	152
CII.—Solanaceæ	...	...	14	52
CIII.—Scrophularineæ	...	...	55	216
CIV.—Orobanchaceæ	...	...	5	24
CV.—Lentibularieæ	...	...	2	23
CVI.—Gesneraceæ	...	...	25	129
CVII.—Bignoniaceæ	...	...	11	27
CVIII.—Podalineæ	...	...	2	4
CIX.—Acanthaceæ	...	...	49	504
CX.—Selagineæ	...	...	1	5
CXI.—Verbenaceæ	...	...	23	128
CXII.—Labiateæ	...	...	56	335
CXIII.—Plantagineæ	...	...	1	10
CXIV.—Nyctagineæ	...	...	3	10
CXV.—Illecebraceæ	...	...	2	2
CXVI.—Amarantaceæ	...	...	17	48
CXVII.—Chenopodiaceæ	...	...	20	49
CXVIII.—Phytolaceaceæ	...	...	1	1
CXIX.—Polygonaceæ	...	...	7	93
CXX.—Podostemoniaceæ		...	3	22
CXXI.—Nepenthaceæ	...	...	1	9
CXXII.—Cytinaceæ	...	...	1	1
CXXIII.—Aristolochiaæ	...	...	4	16
CXXIV.—Piperaceæ	...	...	3	56
CXXV.—Chloranthaceæ	...	...	2	3
CXXVI.—Myristiceæ	...	...	1	32
CXXVII.—Monimiaceæ	...	...	3	3
CXXVIII.—Laurineæ	...	...	18	213
CXXIX.—Proteaceæ	...	...	1	10
CXXX.—Thymebaceæ	...	...	12	19

Order.			Genera.	Species.
CXXXI.—Elæagnaceæ	...	...	2	6
CXXXII.—Loranthaceæ	...	...	5	74
CXXXIII.—Santalaceæ	...	...	8	16
CXXXIV. Balanophoreæ	...	...	2	6
CXXXV.—Euphorbiaceæ	...	...	80	633
CXXXVI.—Urticaceæ	...	...	46	297
CXXXVII.—Platanaceæ	...	...	1	1
CXXXVIII.—Juglandeæ	...	...	2	7
CXXXIX.—Myricaceæ	...	...	1	1
CXL.—Casuarineæ	...	...	1	1
CXLI.—Cupuliferеæ	...	...	6	82
CXLII.—Salicineæ	...	...	2	31
CXLIII.—Ceratophylleæ	...	...	1	1
143 Total Dicotyledons			1,844	10,548

Gymnosperms.

CXLIV.—Gentaceæ	...	...	2	9
CXLV. Coniferæ	...	...	13	25
CXLVI.—Cycadaceæ	...	..	1	5
3 Total Gymnosperms		...	16	39

Monocotyledons.

CXLVII.—Hydrocharideæ	...	...	9	15
CXLVIII.—Burmaniaceæ	...	...	2	10
CXLIX.—Orchideæ	...	...	117	1,270
CL.—Scitamineæ	...	...	24	238
CLI.—Hemodoraceæ	...	...	4	23
CLII.—Irideæ	...	...	3	15
CLIII.—Amaryllideæ	...	...	4	25
CLIV.—Taccaceæ	...	...	1	4
CLV.—Dioscareaceæ	...	...	2	26
CLVI.—Roxburghiaceæ		...	2	5
CLVII.—Liliaceæ	...	...	36	189
CLVIII.—Pontederiaceæ	...	...	1	2
CLIX.—Philydraceæ	..	...	1	1

Order.			Genera.	Species.
CLX.—Xyrideæ	...	...	1	7
CLXI.—Commelinaceæ	...	...	7	76
CLXII.—Flagellarieæ	...	..	2	3
CLXIII.—Juncaceæ	...	...	2	30
CLXIV.—Palmeæ	...	...	34	221
CLXV.—Pandaneæ	...	...	2	12
CLXVI.—Typhaceæ	...	...	2	6
CLXVII.—Aroideæ	...	...	32	227
CLXVIII.—Lenenaceæ	...	...	2	8
CLXIX.—Triurideæ	...	...	1	4
CLXX.—Alismaceæ	...	...	6	9
CLXXI.—Naiadaceæ	...	...	7	26
CLXXII.—Eriocauleæ	...	...	1	43
CLXXIII.—Cyperaceæ	...	...	28	448
CLXXIV.—Gramineæ	...	...	153	854
28 Total Monocotyledons		...	486	3,797

		Orders.	Genera.	Species.
Dicotyledons	..	143	1,844	10,548
Gymnosperms	...	3	16	39
Monocotyledons	...	28	486	3,797
Total Flora	...	174	2,346	14,384

The largest number of genera in one order is 152 in the Gramineæ and the largest number of species in a single order is 1,270 in Orchideæ, no other order contains more than 854 species (Gramineæ).

The following seven genera contain over 100 species :—

Dendrobium	(Orchideæ)	...	...	164
Strobilanthes	(Acanthaceæ)	...	...	146
Carex	(Cyperaceæ)	...	...	142
Eugenia	(Myrtaceæ)	...	...	131
Impatiens	(Geraniaceæ)	...	...	124
Ficus	(Urticaceæ)	...	...	112
Habenaria	(Orchideæ)	...	...	111

Of course since the publication of the Flora (the final volume was issued in 1897) many new species have been discovered. Several have been described in the pages of the *Indian Forester*. Dr. Willis has specially studied the Podostemoniaceæ in Southern India and Ceylon and has, I believe, added several new species. Mr. C. A. Barber in a single trip in the Anamalais added several species to the genus Impatiens, which probaby now would occupy the 4th, if not the 3rd or even 2nd place, in the list given above.

In addition to the list enumerated 132 non-indigenous garden plants are mentioned without being described and finally a large number of species are referred to at the end of the space devoted to each genus under "doubtful and excluded species," etc. Omitting all those shown not to occur within the territorial limits covered by the Flora and those which have been misnamed by previous authors and are therefore described elsewhere in the body of the word under another name. There are 758 species mentioned only or partly described from catalogues or drawings of previous authors. These can be classed under one or other of the following heads :—

Undescribed or imperfectly described (by botanist from whose work it is quoted).

Doubtful species.

Genus doubtful.

Unknown to and not seen by Sir J. D. Hooker (or assisting botanist who dealt with the particular genus).

Indeterminable.

C. E. C. FISCHER.

DEHRA DUN:
21*st July* 1907.

NOTE ON TERMINALIA CHEBULA, AND ITS FRUIT, THE MYRABOLAM OF COMMERCE.

On the Western Ghauts this species does not usually exceed a height of 25 feet or a girth of 3½ feet. The bole, as a rule, is very short, branching often beginning lower than two feet from the ground. The crown is very spreading and the root system shallow. The species is essentially light-demanding. It flourishes

on laterite at an altitude of 4,500 feet; here its chief associate is Eugenia jambolana. The new foliage appears about the beginning of April soon after which the flowers, all bisexual, are displayed in spikes; on an average there are about forty flowers in each inflorescence but the number of ovaries ultimately developing into fruit on a single peduncle does not usually exceed ten. The leaves are mostly sub-opposite, glabrous, shining and coriaceous, measuring $3''$—$6'' \times 2''$—$2\frac{1}{2}''$.

The fruit (the myrabolam of commerce) which is a drupe ovoid in shape and an inch long by half an inch broad in the middle, is also glabrous and appears about the end of May. It is at this time light green with tiny yellow spots; the upper part, perhaps on account of the influence of stronger light, frequently changes to a dark purple maroon.

During the monsoon the fruit turns a greenish yellow. At this period the *hirda* (this is the name by which the fruit is known to the Maharatta) is sold by auction whilst on the tree, and materially adds to the revenues of those Forest Divisions situated in the T. Chebula zone.

The successful bidder begins collecting in October, and for his convenience depôts are erected at suitable centres serving also the double purpose of housing guards. Villagers collect the fruit in bags, baskets and blankets, conveying it to the nearest depôt where individual collections are measured and payment made by the contractor at the rate of six pies per "*ads-hiree*," this is a cylindrical measure $4\frac{1}{2}$ inches in diameter and $10\frac{1}{2}$ inches in depth. Collecting operations continue up to the end of March, most of the *hirda* at this particular time being quite yellow. The fruit at the depôt is at once spread out on ground specially prepared; all grass, loose sand and dirt are cleared away, the area being well swept until its surface resembles that of a clean threshing floor. The *hirda*, having been spread evenly and in a single layer over the ground, is turned over every second or third day to ensure perfect drying in full sun-light, for it is mainly on this process that the ultimate commercial value of the myrabolam depends. On an earthy floor drying occupies, in

fine weather, a period lasting twenty days, but on a rocky area this period is about halved, owing to the amount of heat received by rocks during the day and retained for some time after sunset. Moreover, when dew falls, the moisture is more quickly evaporated from a rocky than from an earthy surface.

A few showers of rain destroy the valuable properties of *hirda;* to contend against any emergency, therefore, the contractor builds one or two temporary sheds in which the *hirda* is quickly stored as soon as the sky becomes threateningly cloudy. The fruit when perfectly dry is a little larger than half its original size. During the drying process it becomes ridged and then the outer layer of the pericarp is hard enough to resist the blade of a penknife. A small percentage of the *hirda*, however, does not become ridged, and in such cases it is found that almost the whole of the interior of the fruit has turned into a black powder which is much used for making ink ; such fruits, known by the natives as "*bhonga*" *hirda*, are considered worthless for dyeing and tanning purposes. The ridged, or valuable dry *hirda*, is next stored in bags and despatched to Europe, a comparatively small quantity being retained for sale in this country. Various decoctions prepared from the chebulic myrabolam are used as cathartics by natives.

The natural reproduction of Terminalia Chebula is generally good. Once germination has taken place the young seedling soon establishes itself, and in spite of repeated fires sweeping through the area the plantlet quickly recovers—thus exhibiting great tenacity of life. Stools, the result of illicit exploitation, coppice vigourously. The leaves of the seedling and coppice shoot are tomentose but this character soon wears away. For purposes of artificial re-stocking a reservation is made by the Forest Department to the extent of one maund (24 *adshirees*) per beat of the forests in which *hirda* is found. Germination is generally backward with regard to the ridged *hirda ;* but that known as "*bhonga*" readily germinates because the hard, stout nut has been transformed into a black powder, and this destruction of the pericarp would appear to be due to a fungus. If this is a fact then we

have an instance of a fungus doing good, instead of the usual harm, by removing the endocarp which, in the ridged *hirda*, seems to be the chief obstacle to successful germination. It is most probable also that a fire may do some good in the case of *hirda*, as it has been said to do in the case of teak.

Injury is done to the inflorescence by a species of Cynipidæ. This insect causes fairly large, irregularly shaped, red galls on the peduncle and in doing so destroys several of the flowers. It therefore is responsible for a large reduction in the crop of the year. The nearer the gall is situated to the base of the peduncle the greater must be the amount of harm done ; since the gall, or galls, to remain in a healthy condition must undoubtedly assimilate a certain quantity of the nourishment during its passage up the main food channel of the inflorescence. Further, the terminally situated flowers (or fruit) must suffer most, and may, because of this deprivation of nutriment, die eventually, the degree of deprivation depending on the size and number of the galls. Species of Rodentia, such as the squirrel and rat, devour the fruit voraciously in plantations.

The wood is considered useful by villagers for carts and agricultural implements, but this will always remain a secondary consideration in comparison with the fruit.

In felling operations T. Chebula is, of course, reserved, and it would be advantageous to prescribe a sylvicultural rule to the effect that the crown should be given full freedom to spread in all directions. Being thus favoured, more light would result in an increase of foliage and the quantity of fruit produced would also correspondingly increase.

A tree yielding annually such valuable produce is certainly good capital. The majority of timber producing species reach the age of exploitability when about from 90 to 120 years old ; there is no reason to doubt that T. Chebula does not attain such an age, and, indeed, continue beyond it, regularly producing from about its fifteenth year a steady interest in the form of fruit.

J. E. C. TURNER.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

TRAPPING OF RHINOCEROS IN THE DINDINGS, STRAIT SETTLEMENTS.

Having read with interest many sporting stories from time to time in the pages of the *Indian Forester*, I venture to think an account of the trapping of a rhinoceros I witnessed in the Strait Settlements, may be of some interest to others.

One day, early in September 1905, a couple of Malays applied for permission from the District Officer to trap a rhinoceros which they came across while out in the forest in the "Ulu" (Malay name for up-country).

Rhinoceros are fairly rare in the Strait Settlements and it is seldom that they are trapped or shot. So being up in the Ulu, on hearing of the proposed trapping, I started for the scene of operations. The next morning the Malays set to work to lay out the trap; but before the actual operations commenced, a little cooked food was offered as a sacrifice to "Dato Utang" (god of the forest) to ensure success in the undertaking.

A rectangular pit measuring 8 feet in length, 4 feet in width and 6 feet in depth was dug, and a good many hardwood saplings of 8 feet in length and 5 to 6 inches in girth were cut for lining the four sides of the pit. These poles were buried 3 feet into the bed of the pit in vertical lines as close together as possible, and were further strengthened and held in position by horizontal poles, the ends of which were inserted into the sides of the pit, the end vertical poles being tied on to these horizontal poles.

The dimensions of the pit or trap are more or less proportionate to those of a full grown rhinoceros. The reason for the lining of the pit with vertical poles is to prevent the rhinoceros from using its horn and feet in digging and so making its escape. After the poles had been fixed in position a space of one foot was left all round the pit from the top of the poles to the surface level. A cover of interlaced leafy branches was then made and placed over the opening of the pit the ends of which rested on the top of the vertical poles. Over this covering a layer of loose earth was put, and brought to the same level as the ground surface. A part of the excavated earth was used for building two small "bunds" which ran parallel with one another for a distance of a couple of yards from the edge of the pit towards the direction from which the rhinoceros was expected, and the surplus earth was carried away and deposited some distance from the site of operation. After this, all the remaining twigs, cut branches, leaves and earth were

taken away, and the disturbed surface round about was brought to its original condition by the spreading of dead leaves evenly all over the surface.

One has no idea how particular Malays are when engaged on this kind of work; although they are, as a rule, heavy smokers, not a "Kokko" (a Malay cigarette) passed their lips throughout the whole day while engaged in laying the trap, and when I pulled out a cigarette to kill time I was politely asked not to smoke, as rhinoceros—according to the Malay—can scent a human being a mile off.

We left the forest at 6-30 P.M., and camped on the banks of the Sungei Betting Luas (river) for the night in a roughly made hut, raised about 6 feet from the ground on poles. Early next morning a couple of Malays were told off to inspect the trap from a reasonable distance and to return at once and report; but we had no luck that day. After inspecting the forest on the opposite bank of Sungei Betting Luas I returned and spent another night in the hut deciding, however, to shift next morning if nothing turned up; but luck favoured us, for the exciting news was brought in early next morning from one of the watchers: that a "Badah" (rhinoceros) had fallen into the trap! I set off at once with my guards and the remaining Malays armed with a couple of my guns and "Parangs" (Malay knife).

The rhinoceros, on catching sight of us, became furious, and it's grunting was sufficient to make brave hearts quail. Any way with all it's grunting, and struggles to escape, it was quite safe in the trap. It was a magnificent specimen of a three-quarter grown bull rhinoceros, it had a horn about $2\frac{1}{2}$ to 3 inches long and stood from $4\frac{1}{2}$ to 5 feet in height: its skin was of a dark reddish brown colour.

The Malays, after a great deal of excitement, set to work to build a cage, (which is constructed of hardwood saplings and rattan cane and its dimensions those of the trap). After it had been completed it was carried and placed on the edge of the trap, the open end facing the animal's head. Two lines of poles were driven in running from the mouth of the cage to a little

beyond half way down the side of the pit, so as to prevent the rhinoceros from escaping when driven out of the trap.

The Malays, after consultation amongst themselves as to the best way of getting the rhinoceros out with as little harm as possible to the animal as well as to themselves, decided to get the animal to run into the cage from the trap of its own accord, and the following method was adopted :—

Four men took up their positions, two on either side of the pit, and started to shovel earth into the trap in front of the animal. As the earth was being poured in the rhinoceros shook it off its head and back and trampled it under foot so that within a couple of hours there was sufficient earth in the pit to encourage the rhinoceros to make a desperate attempt to get out, in which, however, it failed. In the meantime a couple more Malays took up their positions, one at the end of the trap facing the animal's back, armed with a sharp pole, while the other placed himself on one side of the open cage ready with a pole to close the mouth of the cage when the rhinoceros ran into it. After another half hour's work the animal, with a desperate effort, managed to struggle out and run headlong into the cage, and before it had time to back out again, the mouth of the cage was closed by the Malay thrusting the pole through the vertical bars and thereby holding the animal prisoner. Although there was hardly any room in the cage for the rhinoceros to use its strength, still its struggles to free itself were tremendous, and it would very likely have succeeded had not the men been on the alert and further strengthened the cage by strapping additional horizontal poles on to the sides.

After this the animal was left alone without food for the rest of the day and the best part of the next, in order to reconcile it to its fate and force it to give in through starvation and exhaustion.

A thank offering was then made to "Dota Utang's" consideration in favouring their enterprise, a few prayers were said in token of gratitude, and the beatings of tomtoms commenced to celebrate their success. In the meantime a couple of Malays were sent into Lumni— the Government head-quarters of the Dindings—to inform

the District Officer and make the necessary arrangements for shifting the rhinoceros from the forest.

I left early next day for Betting Luas with the guards and returned four days later along with the two Malays who had gone to Lumni. I was rather surprised to observe the marvellous change that had come over the rhinoceros, undoubtedly its spirits were completely subdued, it actually allowed itself to be fondled and dug at without a grunt or any other sign of vexation. On the third morning of its capture it was fed on jack-leaves (Arthocarpus indica) and herbaceous plants on which it chiefly lives.

A point of interest, that here may be mentioned is the commercial value of rhino urine and dung. These were regularly collected, the rhino staling about 2 bottles of urine at a time, and I was witnessed to the sale of one bottle of urine for Rs. 8-12-0. This is used for rheumatism by the Chinese and the urine is powerful enough to raise blisters on human skin.

To come back to my narrative, a good part of the next day was idled away awaiting the return of a Malay, who had been sent to reconnoitre the forest and fix on the easiest route to the bank of the Sungei Betting Luas. On his return, preparations were made for shifting the animal.

While the animal was being fed and his attention drawn away a couple of poles were removed from the bottom of the cage underneath the animal's feet, the rhinoceros was then made to shift a bit, causing its four feet to slip through the open space at the bottom of the cage left by the removal of the two poles. The cage was then lifted about a foot from the ground and held in position by six sturdy Malays while a couple more were busy fixing three horizontal poles that were passed through the cage over the rhinoceros' back, then four more poles were passed through the bottom of the cage and similarly fastened so as only to allow sufficient space between them for the animal to move its legs at a walking pace. The idea of this was to cause the rhinoceros—although a captive—to carry its own cage and shift itself along, instead of being carried, which would incur a great deal of risk, labour and expense.

Rattan ropes were then fastened on to the four corners of the cage, a fifth being fastened in front, and all were held by Malays. The four men—two on either side—pulled away from one another, whilst the fifth dragged and guided the captive rhinoceros in the right direction. One more man (the sixth) walked close behind the cage occasionally goading the rhinoceros to make it move on.

Early next morning we left the forest for the Sungei Betting river, which we reached late in the evening. A couple of days were spent here getting a large size "Sampang" (Malay boat) up the narrow stream. A wooden contrivance, in the meantime, was built for loading the animal into the boat. Early on the third day the cage was loaded into the boat and we started for Lumni, which was reached on the second day.

Altogether 10 days were taken from the time the animal was captured to the time it was brought safely into Lumni.

Luckily there was a steamer leaving for Penang on the afternoon of the day of our arrival at Lumni and the rhinoceros was put on board, one of the trappers accompanying it. On the return of the Malay I learnt that the rhinoceros was sold to a Muhammadan merchant for the paltry sum of 200 dollars. Three weeks afterwards when on a visit to Penang I learnt that this merchant had sold it to another merchant in Singapore for 500 dollars, who bought it for the purpose of selling it to the Madras People's Park.

Being interested in the welfare of this rhinoceros I made further enquiries and found out that it had been exported from Singapore to Madras and sold for Rs. 1,500. I am not in a position to vouch for the above statement, but this is all I could gather as to the disposal of the animal; any way, it was not in Singapore when enquiries were made by me.

GRANVILLE M. O'HARA,
Forest Student, Dehra Dun.

EXTRACTS FROM OFFICIAL PAPERS.

GOVERNMENT OF INDIA'S ORDERS REGARDING THE CARRYING ON OF CORRESPONDENCE BY THE OFFICERS OF THE IMPERIAL FOREST RESEARCH INSTITUTE, ETC.

Circular No. 18-F/189-2, dated Simla, the 30th May 1907, from C. A. Innes, Esq., I.C.S., Under Secretary to the Government of India, to all Local Governments and Administrations (except Madras and Bombay).

In continuation of the Circular of the Department No. 26-F., dated the 26th September 1906, I am directed to forward, for information, a copy of (1) Rules for the guidance of the Inspector-General of Forests and members of the Imperial Forest Research Institute in carrying on correspondence with Local Governments and local officers, and (2) Rules for the guidance of members of the Imperial Forest Research Institute in the conduct of special investigations

2. The rules, which have been accepted by all the Local Governments concerned, are sanctioned by the Government of India.

Rules for the guidance of the Inspector-General of Forests and the members of the Imperial Forest Research Institute in carrying on correspondence with Local Governments and Local Officers.

(i) When the Inspector-General of Forests considers it desirable that a Research Officer should visit a province, he will obtain the permission of the Local Government to the proposed tour, and ask it to make all necessary arrangements to aid the Research Officer in conducting his local investigation.

(ii) When any particular investigation has been sanctioned by the Inspector-General of Forests, he will inform

the Local Governments concerned. The Research Officer may then correspond direct with Conservators in connection with such investigation, with the object of collecting information or specimens, or on matters of purely scientific interest; and may with the Conservator's special permission, conduct such correspondence direct with Divisonal Forest Officers under his control.

Rules for the guidance of the members of the Imperial Forest Research Institute in the conduct of special investigations.

1. No investigations may be undertaken without the previous approval of the Inspector-General of Forests. When any member of the Research Institute desires to undertake a new investigation, whether on his own initiative or on suggestions received from others, he should submit his proposal to the Inspector-General in the same form as the annual programme.

2. By the middle of September in each year, each member of the Research Institute will submit, through the Principal, to the Inspector-General of Forests, a programme of the Research work which he proposes to undertake during the next twelve months, showing the subjects of investigation proposed, and the localities in which it is intended to prosecute research. The programme will be in the following form :—

(i) Proposed subject of investigation or research (to be definitely stated).

(ii) Province and locality in which it is proposed to conduct the investigation.

(iii) Approximate dates of arrival and termination of visit.

(iv) Dates on which visits are to be paid to students' camps.

(v) Officers with whom correspondence is desired.

(vi) Remarks.

3. When the Inspector-General has approved of the initiation of an investigation, he will address the Local Governments concerned in order to obtain their approval of the proposed tour,

assistance in carrying it out, and permission for the Research Officer to conduct correspondence on the subject with the local officers.

4. When a Research Officer is on tour, he should keep the Inspector-General informed, by means of demi-official letters, of the progress of his tour, and should intimate to him at once any change of address. He should also keep the Inspector-General acquainted with the progress of any investigation in which he is engaged. The Inspector-General may, should he think it advisable, direct two or more experts to form a committee for the elucidation of any particular subject of research.

5. Research Officers may conduct all necessary correspondence with private individuals, but they may not correspond direct with Local Governments or Administrations, and must be careful in communicating with officers of the forest and other departments to conduct their correspondence in accordance with the general or special orders of the Local Government concerned.

6. A Research Officer, or the senior member of a committee of Research Officers, may correspond direct with the Inspector-General of Forests in connection with sanctioned investigations. The correspondence regarding each subject of investigation should be kept in a separate file.

7. When an investigation has sufficiently advanced, or has been completed, the results will be embodied in a note, report or record, which will be submitted to the Inspector-General of Forests; and, if he considers it of sufficient importance, will be printed and circulated, so that the conclusions arrived at may be permanently recorded and made available to the public.

ORIGINAL ARTICLES.

IS A PERIOD OF REST, AND ROTATION OF CROPS, WANTED FOR TEAK REPRODUCTION?

In 1862 Colonel Beddome explored the Nallamalais of Kurnool and found that there was an abundance of teak; but, whereas in the Anaimalais in those days it attained a girth of over 22 feet, in the Nallamalais it did not grow above 8 or 9 feet girth, and therefore, although the grain was reported as beautiful, it was considered inferior; moreover he found that the wood-cutters were busy exterminating it as rapidly as possible: "fine young trees only 4 to 5 inches in diameter lying ready to be carted, 16 of these are placed in one cart, which is charged a seigniorage of Rs. 2, Government thereby only receiving a seigniorage of annas 2 per tree."

This policy continued for another 20 years, that is, until the Madras Forest Act was introduced, when all teak felling was proscribed as being a "Reserved Tree." The result of this reckless felling, combined with the increasing intensity of the forest fires (Mr. H. F. A. Wood in his working-plan for the Terai forest has most ably traced this increasing intensity) resulted in teak being confined to comparatively small patches in these Nallamalais Hills, which extend over 2,000 square miles, instead of being fairly well distributed over the whole area.

When I took charge of the Kurnool district in 1898, I was struck by a remark made by my brother, P. W. Lushington, who had preceded me there some years previously, that in a small area at Jangambhavi, that had been clean felled, teak had sprung up where no teak had previously existed; and, following up this remark, I noticed that there was in this Chelama plateau, practically no teak except—(1) in the patches which, like Jangambhavi, had been clean felled; (2) along the line of rail; and (3) along cart-tracks, fire-lines, and other opened areas; and I further noticed that there was no teak existing, which could have produced seed, within a radius of about 30 or 40 miles.

The station of Chelama is on the Southern Mahratta line of rail, about half way through the forest from Nandyal to Giddalur (two taluk headquarters), and about three-fifth way down these hills from north to south in the Kurnool district; it is situated on a plateau about 1,500 feet above the sea, and 700 feet above the Nandyal and Cumbum plains; about 6 miles to the east of it, towards Cumbum, is what is known as "*The* Tunnel"; and just below (eastwards) this tunnel is the Jangambhavi plot, referred to above.

In 1898, the forest of this plateau consisted mainly of white wooded trees: *Sterculia*, *Cochlospermum*, *Dalbergia paniculata*, *Bombax*, *Odina*, also an abundance of *Terminalia belerica*, "a tree with a devil in it" according to the native idea, and a few scattered trees of *Hardwicka*, *Anogeisus*, *Satinwood*, and so forth. So poor was the forest, that to encourage the better species, my immediate predecessor, Mr. F. A. Lodge, had ordered the white-wooded trees to be ringed; later they were sold to contractors, who, default better species, transported them to Bellary, where they were passed off as congeners of the best species; thus the two *Sterculias* (*urens* and *villosa*) were called "Red Terminalia tomentosa" and "Wild Adina cordifolia." *Terminalia belerica* was also called a kind of Terminalia tomentosa, one of them was called Red Pterocarpus marsupium; but this was not discovered till some years later. Teak, and indeed all the better species, were conspicuous by their absence except in the opened areas above referred to

Proceeding on leave shortly after, and then transferred to the Southern Districts, the matter escaped my attention until I returned as Conservator of the Northern Circle in 1903. In the meantime, in 1901, Mr. Cowley-Brown had been engaged in preparing a working plan for the area all along the railway, from Gazulapahi. where it enters on the west, to Deguvametta, where it leaves it on the east. In his operations on this working-plan he had clean-felled a fairly large area all round Chelama station in order to find out the yield of material per acre. When I saw it two years after felling, it had the appearance of a well-stocked young teak plantation. The working-plan has now been in operation for six years, six coupes felled; and everywhere where the coupes have

been felled *on this plateau*, the spread of teak has been most marvellous; from the more elevated open spots they can be seen far and wide, especially at this time of the year when their young but large leaves are a glaucous or whitish green on the lower surface, and the wind blowing, shows them up. I italicise "on this plateau," because similar fellings in the Terai on the west have resulted in a thorny mass of climbers (Zizyphus, Pterolobium, Convolvuli and Asclepiads, and the like) with but little growth of the better species; whilst the hillocks in the plains on the east have mostly become denuded except of grass; misfortunes, only ascertainable by experimental working, which we are now hoping to retrieve by other measures.

The forests on this plateau now contain not only an abundance of teak, but also innumerable young Black-wood, *Pterocarpus marsupium*, *Terminalia tomentosa*, *Lagerstrœmia*, *Satinwood*, *Hardwickia*, *Anogeissus*, *Gmelina arborea*, *Grewia tiliæfolia*, and other good species, and has in fact become a most promising first class forest; it is probable that the rainfall on this plateau is some six inches greater than in the plains below; but from recent gauging it would seem that the rainfall below is increasing, even during the past few years of comparative drought in the open plains beyond where it has decreased. The question is: where does this abundance of young regrowth of the good species on the plateau come from, seeing that some eight or nine years ago there was none of them?

It has been suggested that my memory has played me false and that these species must have existed, and that I failed to notice them. I am sure that this is not the case; but I waited until I had convincing proofs before taking further action. In 1898, another brother from the Bombay side came on a visit to me at Nandyal, and I took him to see these Chelama forests; accustomed as he was to the Belgaum and Dharwar forests, he somewhat despised the Chelama forests because they contained no teak; coming again on a visit to me at Waltair last year, and passing through the Nallamalais by this line of rail, one of the first questions that he put to me was to ask what we had been doing to these forests as we had converted them into regular teak areas.

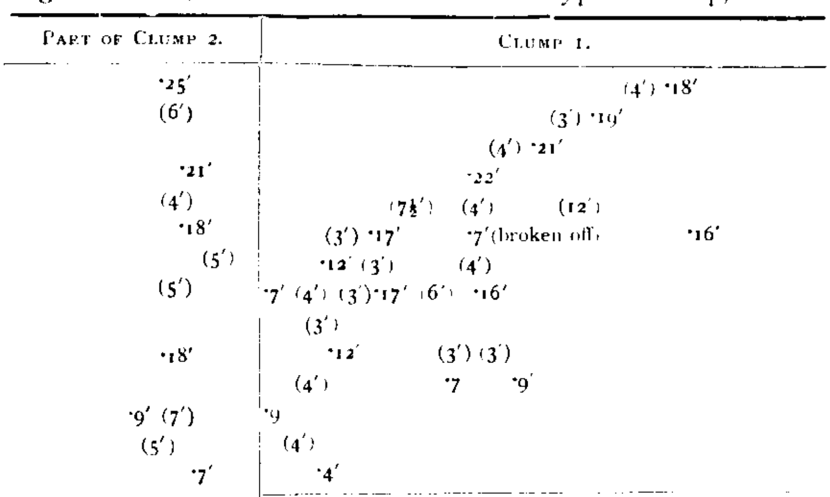
He was in the Survey and Revenue Settlement in Bombay, and the observation was that of casual observer.

I have recently been spending a week in this area with an endeavour, amongst other things, to solve this problem ; in one of my excursions, with Extra Assistant Conservator, Mr. Asvatham Naidu, along one of the fire lines cleared last year, we found an abundance of teak, Blackwood, *Pterocarpus*, and *Terminalia* coming up, as apparent seedlings, although there were no trees of the species, at all events of teak, over two years old within half a mile at least of the line in question. Again, the line of rail was constructed in 1885 ; the oldest trees in the plateau appear to be along this line of rail ; there they appear to be just about the age—22 years—such that they were produced by the clearing of the forest for the line of rail.

It has been suggested that the young treelets now appearing are coppice shoots from older trees ; a careful examination of the ground during this last week does not corroborate this suggestion at all ; there are indeed a few of such coppice shoots, but they are invariably shoots from very small stumps and are probably the result of a cutting back after the first clean felling was made. By far the greatest majority look like seedlings, pure and simple, though in some cases they are undoubtedly sucker reproduction. In either case, seedling or sucker shoot, they must have lain dormant for very many years. It may be remarked that the local teak seed at the present day is exceedingly sterile, as Mr. H. F. A. Wood can testify from his trial of the seed in his plantations all down the west side of the Nallamalais ; only one seed out of hundreds of drupes germinates ; and he has therefore been obliged to indent on Southern Districts for teak seed. In these circumstances it is highly improbable that the treelets now coming up are the results of seed dropped from existing trees. In Brandis' Forest Flora of N.-W. and C. India, we find : "the germination of the seed is slow and somewhat uncertain.........when seed is sown in nurseries, it generally takes about a fortnight before the first seedlings show themselves above ground, and they continue coming up successively for a considerable period, numerous seedlings appearing

during the second and third year, and a large proportion not germinating at all." If the seed retains its vitality such that in a well tended nursery many seeds do not germinate till the third year, surely there is nothing very wonderful if it retains that vitality very considerably longer in localities not at the time suitable for its germination; for, as Brandis points out, "the large amount of moisture is required to saturate the spongy covering," and even then the stones within the drupe have to be permeated before the seed is reached.

Just in front of the Chelama forest bungalow there is a little plot —a portion of the area clean-felled by Mr. Cowley-Brown—of 3·33 acres, bounded by the cart-track to the village, the village site, the railway line, and a path straight from the bungalow to the railway line. The teak in this plot is fairly representative of what is developing in the whole of the coupes; it is not evenly distributed throughout, but occurs in clumps or clusters with considerable blanks between,—blanks as far as teak is concerned, but full of small seedlings of Blackwood, *Pterocarps*, Satinwood, *Lagerstrœmia*, *Grewia* of three sorts, and others; but with a good deal of grass which, however, is scanty under the teak. From the diagram below, taken of a more or less typical clump, with a



NOTE.—The dots represent the position of the different teak trees, the figures out of brackets the height of the trees, the figures in brackets the distance from one tree to the next.

portion of the next clump adjoining it, it will be seen that the small trees are mostly too far apart for coppice reproduction; it looks very much like sucker reproduction, with the larger trees in the centre radiating off in all directions; nevertheless, as has been said before, the majority really look far more like seedling reproduction and on the fire line referred to above I hardly think it can be otherwise. The total number of teak trees of all ages from the younger seedling to those about six years old was 228, thereby giving 69 per acre; the largest were about 4 inches diameter. This is not a very large number owing to the blanks; yet they form a very conspicuous mass and it is obvious that they could not have been overlooked, had they existed thus, eight years ago. Blackwood is in even greater numbers, and all the better kinds above referred to are equally numerous with the teak and fill in the blanks; but all except the teak have been cut back again, possibly to let the teak develop, but this has resulted in the latter throwing out a superabundance of lateral branches.

From what has been said it is evident that in the sixties or later teak was abundant in these forests; in the eighties and nineties a totally different class of forest arose by which the teak was temporarily ousted; and when in and after 1901 this white-wooded type of forest was cut out, teak accompanied by all the better classes of timber is in considerable proportions, regenerated itself again. Turning to the annals of other teak forests we almost invariably read that there is a considerable amount of difficulty in getting teak to reproduce itself in areas where it has existed and is being cut out. Do we not hear in Burma that bamboo growth springs up which effectually blocks the young teak from coming up? Have we not heard of firing the forests being advocated in Burma to stimulate the reproduction? Has not Mr. Ryan brought to notice that on the Bombay side a prolific root-sucker reproduction of *Trewia*, *Helieras* and *Randia* "may be characterised as distinct hindrance to the natural regeneration from seed of other valuable timber species in the localities they inhabit?" Is not precisely the same phenomenon taking place in the Anaimalais of this Presidency, where an overwhelming

mass of thorny Acacias and other creepers is frustrating the natural reproduction of teak? This being so, is it not possible that this is merely one of the phases of teak reproduction? That it is essential that there should be a period of rest between two crops of teak, possibly in order that the new intervening species may bring back to the soil those ingredients which the teak requires and removes, or possibly to remove some of the matter left behind by the teak which by the removal of the material required, becomes in excess and perhaps poisonous to the teak."

24th August 1907. A. W. LUSHINGTON.

IMPROVEMENT FELLINGS.

BY H. C. WALKER, I.F.S.

All organic beings tend to increase rapidly, but this tendency is counterbalanced by destruction. "In looking at Nature," says Darwin, "it is most necessary to keep the foregoing considerations always in mind—never to forget that every single organic being around us may be said to be striving to the utmost to increase in numbers; that each lives by a struggle at some period of its life; that heavy destruction inevitably falls either on the young or old during each generation or at recurrent intervals. Lighten any check, mitigate the destruction ever so little, and the numbers of the species will almost instantaneously increase to any amount." This principle is adopted in the case of game preservation. Under natural conditions game is scarce as it suffers heavily from the depredation of vermin, but if the vermin are kept down the game instantaneously increases to such an extent that on a single estate hundreds of head of game can be shot in a year.

In the Burma forests teak is much the most valuable species from a commercial point of view. In fact in many divisions, as in my own, it is the only species which can be extracted at a profit. Teak however is scattered here and there, and even in the finest forests only forms a small proportion of the growing stock Our object is therefore exactly the same as in the case of preservation

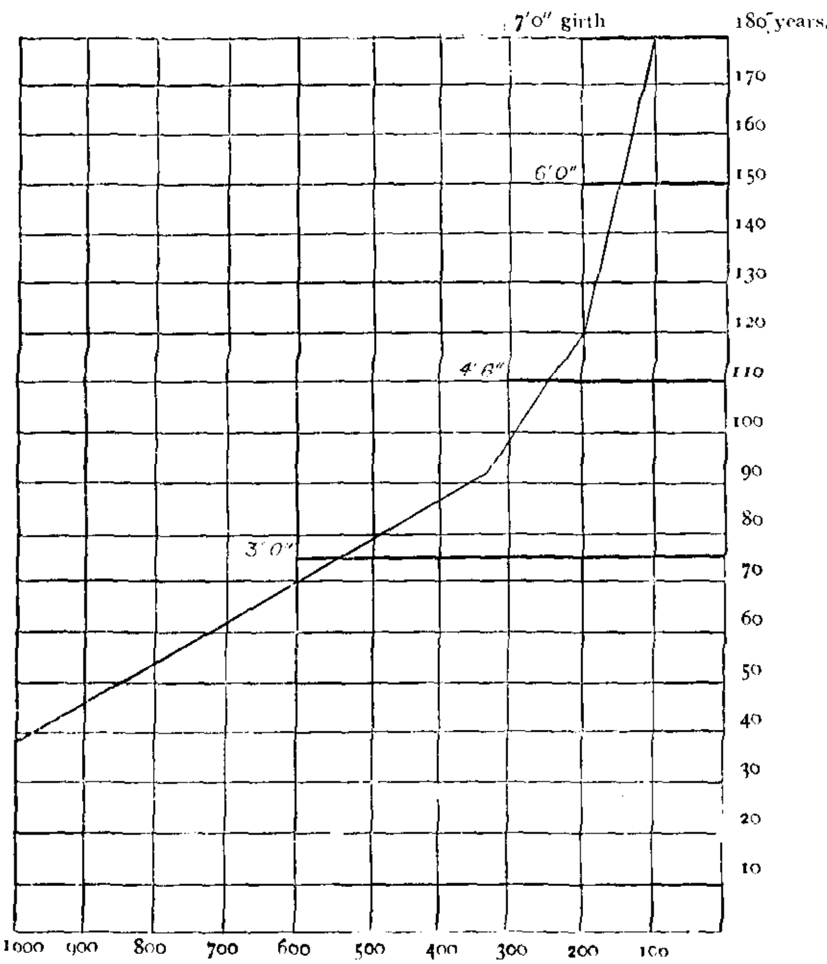
of game. We wish to so increase the growing stock of teak and other valuable species of trees that we can safely take out a greater outturn of timber. We should therefore adopt the same principle, and should prevent the great destruction of teak.

Teak tends to increase at a very rapid rate. One single tree bears so much seed that, if each seed could be ensured to germinate in a fitting place and if each plant could be protected till maturity, this tree would give rise, in the course of a century, to several million descendants. The destruction must therefore be enormous as otherwise teak would stock every area in Burma where the soil and climate are not uncongenial, and would form pure forests. What therefore is the principal cause of destruction? Many Forest Officers think it is fire. From some observations I have made I believe that the growth of teak is vigorous and that seedlings germinate readily in areas burnt over, and in fact natural teak is only found in such areas. Although fire is destructive to vegetation, growth and reproduction are so rapid that any blanks are immediately filled up, and consequently teak forests are, in spite of annual fires, fully stocked with vegetation. The result of eliminating fire is not to increase the quantity of vegetation but merely to cause a redistribution in the proportion of the species that constitutes these forests. The effect of excluding fire can perhaps be best explained by an illustration. Tectona Hamiltonii is a fairly common tree in the dry zone, but as the trees are frequently stunted on account of the drought one might therefore expect that if the dry zone forests in which this species occurs could be artificially irrigated, a more valuable growing stock of the species would be obtained. However as one passes from the dry zone to gradually moister localities, instead of finding a more valuable crop of this species, one finds that it becomes scarcer and scarcer until it gradually disappears. Therefore although this species suffers from the drought it would suffer still more from increased moisture as it would be brought into severer competition with other species, and its principal advantage in the struggle for life, namely, its powers to resist drought, would be lost to it. So it is with teak in the case of fire, and it is even possible to

approximately estimate how long a forest has been protected from fire by the scarcity of young teak. Moreover if fire is the principal cause of destruction of teak, fire-protection should immediately cause an increase, but this is not found to be the case.

If teak can multiply itself a million-fold in a few generations what is the principal cause of destruction which prevents this increase if it is not fire? I think there can be little doubt that it is because the forests are already densely stocked with vegetation so that teak seedlings, saplings and trees which do spring up, can only in exceptional cases obtain sufficient room for development. There is ample proof that growth causes great mortality. In an even aged plantation 1,200 seedlings may be planted per acre, but in the course of 100 years these will dwindle down to 50. There may be very little difference in height, but any slight difference is accentuated and increased, and if a plantation is visited after years it will be found that half the trees have been killed, or are so badly suppressed that unless aided by thinnings they are doomed to destruction. The damage is less showy and striking than that of fire, and the difference is as great as that of bleeding wounds which however are frequently not dangerous, and that of a disease such as consumption which gradually impairs the vitality and usually proves fatal. Teak has to struggle with many species, many of which are faster growing, and it is very sensitive to shade. These species by their growth mutually destroy each other in large quantities, and it is only in exceptionally favourable circumstances that teak can endure through the seedling and sapling stages and reach maturity. The damage to teak that is caused in this manner can, however, be readily avoided. In an oak and beech forest it is customary to constantly cut back the comparatively worthless and faster growing beech wherever it is endangering the oak and no difficulty is experienced. It would be equally simple to free teak from the worthless species which prevents its proper development and growth. In my opinion our forests should be gone over systematically and every teak should be examined every ten years, and whenever a teak tree sapling or seedling is in danger of suppression, it should

be freed, and at the same time other works might be carried out where necessary, such as pruning forked trees, cutting away creepers, coppicing small stems badly injured by fire, etc. By these means I believe the principal causes of destruction would be eliminated, and that as many teak would be saved from destruction the growing stock would immediately respond to the treatment and increase. The trees we are felling now are trees which have endured successfully without any aid whatsoever, but the annual rings of almost every stump I have seen show, by their contraction,



that at some stage of its growth the tree must have been suppressed. Therefore apart from the increase in numbers these works would result in a great increase of increment. Many trees are forked low down, or are badly shaped, and much of this danger could be reduced by prunings when the tree is young. There is, I think, reason to believe that trees badly suppressed are more susceptible to injury by fire, and by freeing them their growth would be stimulated and they would be in a better position to resist fire.

I have endeavoured to calculate what increase may be expected in the growing stock of teak if the principal causes of destruction are prevented. To explain my calculation I have prepared a graphic representation of a growing stock of teak This is fairly typical of the distribution in the various age classes of teak on the Pegu Lomas, as it is based on the estimates given in working-plans for an area of 1,200 square miles. It will be noticed that teak in the younger age classes is more abundant than in the older age classes. I examined the figures of several working circles and found this to be the case in every one. It is an invariable rule in Nature that if a species is subject to great destruction there is a great production of young to counterbalance it. Thus all plants produce great quantities of seed because there is great destruction of seed and seedlings. The elephant only produces one calf periodically, the Fulmar petrel (which is one of the commonest birds in the world) only produces one egg a year and therefore it is obvious that they are liable to little destruction. It may therefore be assumed that the abundance of teak in the younger age classes will be counterbalanced by destruction, and that, whereas there are now 540 teak trees 75 years of age, these will gradually dwindle down so that at the age of 180 there will be only 100 trees. Teak in fact shows a tendency to increase very rapidly, but under ordinary circumstances I believe the mortality would be so great that the growing stock, which I have represented in the diagram, would only yield 100 trees a year. If, however, all causes of destruction could be eliminated the growing stock would immediately increase, so that for periods of 30 years the same growing stock would yield in the first period an average annual

yield of 140 trees, in the second period 200 trees, in the third 260, in the fourth 350 and in the fifth 920. The increase would be geometrical and would subsequently be much more rapid. This is the maximum to which the growing stock could be increased, but in practice I do not think it would be possible to prevent all destruction. There are many soils so shallow and poor that however great care was taken teak would not attain a girth of seven feet. I do believe however that under systematic improvement fellings most of the destruction to which teak is liable, and particularly suppression by worthless species, could be prevented and that in any forest the outturn could be doubled in 100 years and quadrupled in 150 years.

A division averages about 1,000 square miles of reserves, and to carry out this scheme 100 square miles would have to be gone over annually. This would occupy the staff very fully throughout the working season, and would be quite impracticable if many other works had to be carried out. Many officers wish to carry out elaborate works to assist regeneration of teak when the bamboo, with which it is associated, flowers and dies. From some observations I have made I do not think such works would be successful, and there seems no need to assist regeneration. Teak reproduces itself abundantly, as my diagram shows, and if care is taken to ensure that every seedling which germinates reaches maturity, this will take us all our time and will result in a much more rapid increase of the growing stock. The futility of making plantations has now been recognised. It seems waste of energy to spend day after day cutting down unmarketable teak saplings in plantations when the same amount of labour devoted to the more widely scattered natural teak seedlings and saplings would enable many more trees to reach maturity. No progress can, however, be made until fire protection is abolished, as this work occupies the staff for almost the whole of the working season, and requires almost all the money that can be obtained for the improvement of the forest. There is, however, some reason for hope. The scheme that was sanctioned a few years ago to extend fire-protection so as to include within a period of five years *every* teak reserve in Burma

has been abandoned, and it is no longer considered disloyal to state objections to fire-protection, but it will be a long time before it is abolished, especially in dry forests characterised by *Dendrocalamus strictus*. If, however, those officers who, by their advocacy of fire-protection, are responsible for involving the department in a large annual expenditure, and in almost entirely occupying the staff on this work would be less vague and would endeavour to calculate more carefully the profit and loss of fire-protection, they would, I think, realise the futility of it. About ten years ago Mr. Nisbet urged very strongly the need for improvement fellings, but his proposals were objected to on the ground that teak taungya plantations were more important. This decision has now been reversed, as plantations have been given up in favour of improvement fellings, but much valuable time has been lost because the subject was not more thoroughly gone into in the first instance, and this only emphasises the lack of attention given to important sylvicultural questions and the consequent vacillating policy that is adopted. The following figures which are obtained from the Annual Report of 1904-05 shows that as yet we do not carry out extensive improvement fellings :—Fire-protection Rs. 2,64,689; plantations Rs. 1,00,622; others works of improvement, including I believe thinnings in the older plantatiors, Rs. 44,469 for an area of 128,212 square miles of reserved forests. The staff is ample to carry out extensive improvement fellings, and sufficient money would be available were fire-protection and other less important works given up. Most officers in Burma are in favour of carrying out extensive improvement fellings, but at present it is not the "*dustoor*" and the staff and money available is insufficient.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

THE EFFECT OF STRYCHNINE ON WILD DOGS.

SIR,—I venture to address you with reference to Mr. Witt's letter on the difficulties of poisoning wild dogs with strychnine, which appeared in your number for July, as the method I employed proved successful.

I prepared an emulsion of strychnine using about 10 grains of strychnine and a tumbler of water. Strychnine dissolves tardily, but a perfect solution is not required: it can be procured however by the addition of a small quantity of acid. This solution I injected into the carcass with a hypodermic syringe and in places stuck in my hunting knife and poured the solution into the wound.

By this method the poison got well distributed, and not being on the surface did not arouse suspicion. I invariably found that animals that ate of the carcass died and on one occasion the whole pack was found dead around the bait.

On several occasions the dogs had died after vomiting. I have never actually known a case of a dog surviving after vomiting, which is undoubtedly due to an over-dose of the poison ; but it is quite conceivable that an over-dose might act rapidly on the stomach and by an immediate emission almost all the poison might be got rid of: such action is not unknown in the case of other poisons.

I think Mr. Witt will produce more than one vomit for 104 grains of poison (" oh monstrous but one ha'penny worth of bread to this intolerable deal of sack ") if he will dilute his poison and use far smaller doses. One-fourth of a grain is the maximum dose an adult man can take with safety, and this only after having been educated up to it by previously taking smaller doses.

I am unable to believe that the dogs Mr. Witt poisoned actually died and were carried off by their companions; to begin with, the vomit was found apparently at a considerable distance from the kill and the dog must have been alive when it vomited.

I can quite understand a mother of a dying cub trying to drag it away, but my experience of *the pack* is that they are singularly indifferent to the fate of their companions.

Mr. Witt's concluding note regarding dogs having actually attacked a human being is of great interest and probably the first record of such an extraordinary event having taken place.

Medical men are unfortunately unable to throw much more light on the question of strychnine poisoning than their lay brethren as they are not in the habit of administrating fatal doses ; I once however witnessed a doctor administer half a grain to an old dog. It expired in about 30 seconds.

HOSHANGABAD : A. A. DUNBAR BRANDER, I.F.S.
6th September 1907.

EXTRACTS FROM OFFICIAL PAPERS.

MEMORANDUM SHOWING THE RESULTS OF INOCULATION AGAINST PLAGUE IN THE UNITED PROVINCES.

In *Moradabad* the High School boys, about 350 in number, were all, save twenty, inoculated while plague was severe in Moradabad city. Of the twenty who were not inoculated two or

three died of the disease, whilst none of the others were even attacked, although very many of them had plague in their families. One of the boys in class IX of the High School was inoculated along with two brothers and a nephew. Five other persons living in the same house were attacked by plague, not having been inoculated. The boy, his brothers, and nephew were not even ill. All the boys in the Mission Boarding House for boys in the city were inoculated, and no deaths from plague occurred among them, although the surrounding parts of the city were badly affected. A chaprasi and his brother lived in the same room : the former was inoculated but the brother was not. The brother died of plague, but the chaprasi was immune. A well known vakil practising in the Moradabad civil courts was inoculated with his whole household. They lived in a badly infected part of the town. His wife alone contracted the disease, but recovered : she had been inoculated. The registrar kanungo of the tahsil was inoculated, but the rest of his family were not. All the womenfolk of his household died, and, although he personally nursed some of them, he suffered no ill-effects, except that he had a slight swelling of the glands, which disappeared without any treatment. This may have been a mild attack of plague, but the man recovered and was about his ordinary business in a day or two. Of all the cases inoculated only three deaths could be ascertained to have occurred from plague, and in these cases the disease was of a virulent type and came on a few days after inoculation, which appears to indicate that inoculation had been performed too late while the disease was in course of incubation.

For *Bareilly* the following figures have been supplied : 3,257 inoculations were performed in the Municipality ; eight cases of plague and three deaths occurred among the inoculated and 1,743 cases and 1,692 deaths among the uninoculated :—

Population, total.	Inoculated.	Uninoculated.
118,713	3,257	115,456
Plague seizures...	... ·24 per cent.	1·50 per cent.
,, deaths ...	... ·09 ,,	1·46 ,,
Case mortality ...	.. 37·5 ,,	97·07 ,,

In *Meerut* city over 700 persons were inoculated: careful enquiries showed that only one of these subsequently died of plague, and he probably had the poison in him when inoculated as plague was raging in his family. A large number of men in the native regiments, with their wives and families and regimental followers, were inoculated: so far as is known no cases of plague occurred among them. All the Club servants, with one exception, were inoculated: that one man died of plague.

In *Ghazipur* district 786 persons were inoculated, of whom after careful enquiry only six are known to have got plague, and five of these recovered. It is reported that in the town of Muhammadabad out of a family of five persons one woman was inoculated, and she was the only one who escaped plague, the other four dying of the disease.

In *Budaun* two Native Christians, husband and wife, lived in a house near the Budaun Mission School. The wife was inoculated on the 10th April 1907. The husband, who was not inoculated, was attacked with plague on 25th April and died on 30th April. The wife attended on him but remained immune.

In *Lucknow* out of 496 persons inoculated, only one is known to have been attacked with plague: he had it in a mild form and recovered.

STOPPAGE OF PROMOTION FOR PURPOSES OF THE TIME-SCALE OF PAY OF THE I. F. SERVICE.

Government of India's Circular No. $\frac{\text{20-F.}}{\text{193—2.}}$, dated 1st July 1907, to all Local Governments and Administrations.

I am directed to refer to paragraph 3 (iii) of this Department's Circular No. 5-F-38-2, dated the 15th February 1907, regarding the introduction of the time-scale of pay for officers of the Imperial Forest Service below administrative rank.

2. The Government of India have had under consideration the question as to how the length of service of an officer who has had his promotion stopped at any time should be reckoned

for the purpose of fixing his pay under the new scale, and they have resolved to leave it to the discretion of the Local Government concerned to decide, with reference to past orders and its opinion of the officer's work and conduct, how much less pay he should draw than he would have drawn had his work been satisfactory. I am to explain that the penalty would ordinarily take one of the two following forms :—

(1) the increment might be withheld merely for a prescribed period on the expiry of which the officer might be permitted to draw pay as if he had not been placed on stoppage at all ; or

(2) the stoppage of increments might be permanent in its effect so as to postpone the date of attaining all future increments

It is obvious that the latter is a much more severe penalty than the former. In every case, past and future, the authority authorised to impose the penalty should decide which of the two forms it should take, the decision in future cases being recorded at the time of inflicting the penalty.

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INDIAN FORESTER

OCTOBER, 1907.

SOME SUCKER-PRODUCED FORESTS OF THE KISTNA DISTRICT.

The fort of Kondapalli, situated above and immediately west of a village of the same name in the Bezwada Taluk of Kistna District, was built on a saddle in the hills at an elevation of about 700 feet above the plains by the Reddi Kings of Kondavid in the 14th century, and passed from them to the Kings of Vizianagar, of Orissa and of Golconda in turn. It consists of three lines of walls, the innermost of which embrace the plateau of this saddle, the outermost extend nearly a mile distant in all directions, and on the east come down into the village of Kondapalli itself. The Mahomedans constructed a large palace, which covers many acres, the main building of which consisted of three, if not four storeys; but all that now remains of the latter are some corridors on the basement and above, one room, several huge pillars and broken down walls; whilst of the remainder, walls alone remain standing in parts, but on the ground, here and there, are the remains of practically unbreakable concrete roofing. The one room standing in the main building has been converted into a small Forest Inspection house,

which is exceedingly useful and fairly central for a good deal of work that is going on. The Kondapalli range of hills cover an area of over 50,000 acres, some of which is in zamindari land, and rather over 40,000 acres comprise the Kondapalli reserved forest (with its extensions). They rise nowhere above 1,700 feet and usually do not exceed 1,100 feet; and are intersected with plateaux and valleys. For the most part the rock consists either of gneiss or of exceedingly hard black quartzite; and these stand out prominently in, alas! far too frequent outcrops of scarps and bare sheet rock. Proceeding from the present village of Kondapalli at the base of the hills to the Palace bungalow on the saddle, one notices that the vegetation consists of several large clumps of old tamarind trees, scattered largish trees of the white-wooded kinds such as *Protium*, *Gyrocarpus*, *Givotia*, *Sterculia* and figs, and a dense undergrowth about 5 feet high of shrubs and thorny creepers comprising chiefly *Ormocarpum*, *Grewias* (*pilosa*, *villosa*, *orbiculata*, *salvifolia*, *polygama*, etc.), *Cassia auriculata*, *Canthium parviflorum*, *Fluggea*, *Alangium*, *Zizyphus Œnoplia*, *Acacia pennata*, *Capparis sepiaria*, *Pterolobium indicum*, *Randia dumetorum*, *Gmelina asiatica*, *Dichrostachys*, and a few others, whilst a bit higher up there are copious *Anona squamosa*, *Atalantia monophylla*, *Bauhinia tomentosa*, *Helicteres Isora*, *Ixora parviflora*. Beyond the saddle again are numerous *Polyalthia Korinti*, *Strychnos* (*potatorum* and *Nux-vomica*), *Combretum*, *Mimusops*, *Cassia fistula*, *Pterospermum Heyneanum*, *Murraya exotica*, *Webera corymbosa*, *Gardenia lucida*, *Randia malabarica*, *Antidesma diandrum*, *Streblus*, *Cordia* (*Myxa* and *obliqua*), *Grewia tiliæfolia*, *Hugonia Mystax*, *Zizyphus horrida*, *Garuga pinnata*, *Odina wodier*, *Boswellia serrata*, *Feronia*, *Ægle*, *Dalbergia* (*paniculata* and *latifolia*), etc.; that is to say, at the base the species are less numerous, and the vegetation is smaller and less dense, for in the interior it is well nigh impenetrable and is from 15 to 20 feet high. Intermixed with the whole is a terrible mass of prickly pear, which, however, is less and less as the forest vegetation becomes thicker and thicker, but even in some of the tallest and densest forests some of these prickly pear masses are found rising even to 25 or 30 feet in height.

Some eight to ten years ago, on the lower portion the shrubby growth was very sparse and consisted of few bushes 2 to 3 feet high scattered about here and there on the small patches of gravel soil that lodged against the boulders, much browsed down, and with large interspaces between them; and it was from the way that these interspaces had been covered that attention was drawn to the mode of reproduction by which it could have become accomplished. It was noticed that although all these different species, and a very goodly number they represent, were intermingled, yet each species formed defined clumps. This was perhaps most especially noticeable with *Bauhinia tomentosa*, where it often extends over many acres, and then suddenly disappears, *Ormocarpum*, which is much the same, *Atalantia* slightly less so, *Helicteres* still slightly less so, *Strychnos* again less, and so on, until the species become confined to clumps of a few yards square. It was evident that this could not be the result of coppice growth, for, although there is a fair amount of coppice, the coppice clumps are condensed and fairly well defined, and yet there were innumerable stems still left which could not be the result of that treatment The *Bauhinia tomentosa* flowers copiously, and fruits and seeds copiously, and at first sight it might be supposed that the intermediate reproduction was that of seedlings. There were undoubted seedlings about, but these ordinarily presented a very different appearance to the bulk of the stems by being not nearly so robust and by penetrating straight down into the soil, whilst many of the others generally had a somewhat curved appearance at the base, as if the roots had gone off at a tangent to the main vertical axis. *Atalantia* presented the same difficulties; there was undoubtedly a certain amount of coppice growth, and it was producing an abundant crop of fruit and seed; and yet there were similar base curved shoots which did not look like the result of either of these kinds of reproduction. Moreover it was observed that very frequently such shoots went out in radial lines from the larger trees, and in descending order of height. *Ormocarpum* threw further light on the subject; there was practically no rflower or fuit to speak of, at all events over the greater part of the area; and these shoots

were coming up between bushes of 3 feet in height which were not so large as those on which the small amount of flower and fruit was found. The only supposition that these could be there was that the bulk of the vegetation, consisting of the robust base curved shoots, was the result of sucker regeneration. Consequently the root system of all these different species was carefully examined during the next 3 or 4 days in compartments I, II and V of this reserve, wherever opportunity was afforded to do so, with the result that from every one of these species it was found that sucker shoots were being produced in abundance.

Proceeding down the road that divides compartments III and V of this reserve, further corroboration of the sucker-producing habits of these species was plainly visible in the cuttings where copious suckers were found of *Atalantia*, *Ormocarpum*, *Helicteres Antidesma*, *Grewia orbicularis*, *Polyalthia Korinti*, *Garuga*, *Odina*, *Diospyros melanoxylon*, *Xylia*, *Anogeissus*, *Chloroxylon*, *Cassia fistula*, *Ægle*, *Cratæva*, *Feronia*, *Strychnos* (both species). In a stream near the trijunction of compartments IV, VI and VII, suckers of *Terminalia Arjuna* and *Barringtonia racemosa*, were observed.

The next day Kondur Reserve was visited, and on the flatter ground at the base of the hills there was evidently a copious sucker growth, confirmed by finding suckers of *Cassia auriculata*, *Carissa*, *Randia dumetorum*, *Canthium parviflorum*, *Grewia* (*salvifolia*, *rotundifolia*, *orbiculata* and *pilosa*) and *Albizzia amara*; on the slope up the hill, those of *Ormocarpum*, *Bauhinia tomentosa*, *Atalantia*, the two *Strychnos*, tamarind and *Garuga pinnata* were found in great abundance, whilst on the compartment line on the plateau those of *Xylia* and *Helicteres* were very prolific.

Proceeding to Mailavaram the day but one following, in the black cotton soils were found *Acacia arabica*, *Prosopis spicigera*, *Cassia auriculata*, *Balanites Roxburghii*, *Zizyphus jujuba*, *Bauhinia racemosa* all producing copious sucker shoots, whilst near a stream the same was found in respect of *Vitex Negundo* and *Thevetia neriifolia*; on the red soils *Gymnosporia emarginatus*, and on a tank bund *Ailanthus excelsa*, *Mangium lamarckii*, *Carissa* and *Cassia* (*fistula* and *auriculata*). The next day the southern portion

of Velagalapalli Reserve was found to be practically pure sucker reproduction of *Gymnosporia*, *Randia*, *Canthium*, *Ehretia buxifolia*, *Flacourtia sepiaria*, and *Carissa*. The northern portion contains gregarious *Anogeissus*, but this was not verified for suckers; nor was the gregarious *Cleistanthus collinus* in Jangalapalli Reserve, but copious suckers of *Diospyros melanoxylon* were remarked in the latter area.

A few days later camp was pitched at Viziarayi in the Ellore Taluk, and close by there was a young but rather dense scrub jungle consisting mostly of *Glycosmis pentaphylla*, *Flacourtia sepiaria*, *Webera corymbosa*, *Pavetta indica*, *Zizyphus Œnoplia*, *Canthium parviflorum*, *Randia dumetorum* and *Strychnos*. It appeared to be almost entirely sucker reproduction, there was but little coppice growth, and none of the species were large enough to produce flower or fruit, except very casually; and sucker shoots were found in each case. The next day at Dharmajigudem near the bungalow was waste land with scattered patches of scrub, and numerous quarry pits; and in the cuttings of these pits copious suckers were found of all the species which constituted the scrub patches, *viz*., *Cassia auriculata*, *Strychnos Nux-vomica*, *Randia dumetorum*, *Flacourtia sepiaria*, *Carissa*, *Ormocarpum*, *Melia* and *Acacia leucophlæa*.

Finally, the next day in the Velagalapalli Reserve the growth is a dense evergreen scrub, mostly about 20 feet high, with larger trees overtopping it with the semblance of standards. Suckers on their roots were actually collected (a collection was begun here, it is regretted that it was not begun before) of the following species: *Atalantia*, *Randiai dumetorum Dichrostachys*, *Canthium parviflorum*, *Albizzia amara*, *Gymnosporia*, *Erythroxylon*, *Webera*, *Maba*, *Zizyphus Œnoplia*, *Strychnos Nux-vomica*, *Hugonia*, *Cassia fistula*, *Carissa* (which was also found layering), *Mimusops*, *Feronia*, *Ixora*, *Cleistanthus*, *Acacia sundra*, *Bauhinia racemosa*, *Chloroxylon*, *Diospyros Chloroxylon*, *Cassia auriculata*, *Dalbergia paniculata*, *Ormocarpum*, *Pterolobium*, *Combretum*, *Jasminum auriculatum*, *Allophylus*, *Hemidesmus* and *Barleria Prionitis*; and the following species also existed in the forest: *Melia*,* *Terminalia belerica*, *Canthium*

didymum, Strychnus potatorum, Anogeissus latifolia,* Ehretia* (*lævis buxifolia**), *Morinda, Sapindus, Soymida, Hardwickia, Lagerstrœmia parviflora, Grewia* (*orbicularis,* pilosa,* polygama**), *Zizyphu xylopyrus, Diospyros melanoxylon,* Capparis diversifolia, Helics teres,* Fluggia, Mimosa, Tylophora asthmatica, Olax, Flacourtia* sepiaria*, of which it will be noticed that those marked * have been verified as sucker producers in the preceding days; want of time precluded the verification of the others; but it may be remarked that although numerous *Hardwickia* trees had their roots exposed for considerable length, no sucker shoots were at all found upon them.

From what has been said it must be evident that a very large portion of these scrub forests in the Kistna District must be the result of sucker reproduction, and the resultant effect cannot be over-estimated The majority of the areas are covered with growth too young to furnish seed, and coppice could not sufficiently cover the ground; nor is it probable that on the bare hill slopes, where soil is marked more by its absence than its presence, could seedlings thrive or come up in places where the roots penetrate and come to the surface to form fresh growth. The increase in density of vegetation is marked during the last decade upon some of these hill slopes; and a matter of utmost importance is that this vegetation is forming a soil, and a very rich soil, in parts which were previously bare rock. A great many of the species are evergreen and so keep the soil cool and moist even in the hot weather; even the little *Ormocarpum*, although its foliage is very light, is evergreen in this way, that it is perpetually, even through the hot weather, throwing out fresh flushes of leaves whilst the older leaves are perpetually falling off to form soil.

There is one further point to be noticed in this connection; a rain gauge has been kept at Kondapalli for the last 15 years or more; the average rainfall is now found to be over 64 inches; that it has increased in laters years is evident from the fact that 10 years ago a fall of 58 inches was considered abnormally heavy.

In Bezwada, some 10 miles away, the average rainfall up to 1890 was 35 inches; during the succeeding decade it decreased to

31 inches; so that it would seem that this sucker-grown evergreen scrub growth is of material importance in connection with the rainfall, and is for that reason, as well as for its soil-producing properties on the bare rocky hills, a form of growth that should be distinctly encouraged.

A. W. LUSHINGTON,

3rd August 1907. *Conservator of Forests, N. C.,*

Madras.

NOTES ON THE FLOWERING, SEEDING, AND CUTTING OF STROBILANTHES IN JAUNSAR DIVISION IN 1906.

The last seedings of *Strobilanthes* in Jaunsar Division took place in 1882 and 1894, and after 12 years it seeded again in 1906. Two kinds of *Strobilanthes* are well known in Jaunsar Bawar, namely, *S. Wallichii*, local name *Jhanu*, and *S. alatus*, local name *Mashroi*. They are found between 7,000 and 10,000 feet above the sea level in shady places on deep humus soil, in ravines, on northern aspects, under *Rai*, *Morinda* and oak trees but seldom under *Deodar*. These plants are gregarious and are harmful in retarding natural regeneration. They cover large areas in shade to the exclusion of other plants. Every year the upper herbacious portion of *S. Wallichii* breaks off at the node leaving the woody stem beneath which increases in length by one or two inches annually, until at the time of flowering (when the plant dies) this woody portion is two or three feet high, the height of the whole plant being about 5½ feet.

Under orders of Mr. Billson, the D. F. O. of Jaunsar Division, several methods have been tried for its destruction just before the seed ripened, such as cutting the areas covered with it, digging trenches around the cut areas so that seed may not come down with water and snow, and opening areas to grazing.

The exact time for the ripening of its seed being unknown we had to cut the flowers several times but no success was attained.

The flowers began to come out in the first week of July 1906. We began to cut them from the middle of that month, but it was not the proper time, as the cut stems put out several shoots

which in their turn flowered and we were obliged to re-cut them two or three times. Even the branches (cut during the rains) lying on the ground flowered, though not so vigorously.

The plant is a favourite fodder for sheep, goats, and buffaloes but in the months of July and August while the seed is unripe it is injurious and intoxicating to these cattle. hence their owners did not allow them to graze on the plant during these months.

Between 15th September and 15th October the seed ripened and during this period the cattle ate it voraciously without any harm. This period is the best time for cutting the flowers. The plant died by the first week of November 1906.

The seed began to germinate in the first week of September 1907 on those areas over which no treatment was tried, and now the seedlings are about two inches in height, but fortunately no seedling has appeared as yet in the areas treated. Fir seeds were sown in the latter areas and have germinated successfully.

CAMP KANASER :
18th September 1907.

DAYA RAM,
Forest Ranger.

SCIENTIFIC FORESTRY.

It is strange how few men realise what Scientific Forestry means. The *Indian Forester* is divided into parts, for "Scientific Papers" and for articles on forestry and this antithesis implies that forestry is not a science. Botany, Entomology, etc., are thought highly of, but sylviculture is not of much account and the necessity for studying the wants and habits of our timber trees is seldom recognised. Science as defined by Huxley is "knowledge which rests upon evidence and reasoning of a like character to that which claims our assent to ordinary scientific propositions," and as defined in a well-known dictionary is "systematic knowledge regarding any one department of mind or matter; truth or knowledge ascertained by observation, experiment or induction." Surely therefore forestry is scientific when facts relating to the growth and treatment of trees are collected in a scientific manner and combined and arranged into a system.

A science is built up gradually. Simple facts which are almost self-evident are carefully verified and as in Euclid these lead up to and are employed in the proof of other less obvious facts or truths. In France or Germany where forestry is truly scientific, the methods of treatment adopted are the results arrived at "as the fruits of enquiries extending over a considerable period and embrace a vast array of carefully ascertained facts." It is a grave defect of the tuition during our course of training that we are made acquainted with the results without any explanation as to how they have been obtained. It is as though we learnt the facts given in the sixth book of Euclid without learning how these facts were established. The conditions here are so totally different that we cannot utilise the results obtained in Europe, and we have not yet realised that the main lesson we should have learnt from European forests is that we too must ascertain and verify a vast array of facts and evolve from them methods of treatment suitable for these forests.

Our forests have been brought under the management of trained forest officers for about half a century, and there has been ample time to collect information concerning a few of the important timber trees. Yet one finds vast sums of money being spen on works concerning which forests officers have not the vaguest idea what return may be expected. Who knows for example what will be the profit or loss on fire-protection, teak taungya plantations, improvement fellings, etc.? What information have we acquired about the regeneration of teak and the degree of light or shade it requires? Our methods of treatment are based entirely on *opinions*, and concerning opinions Mark Twain aptly says that "I think there is no sense in forming an opinion when there is no evidence to form it on. If you build a person without any bones he may look fair enough to the eye but he will be limber and cannot stand up; and I consider that evidence is the bones of an opinion." Contrast with this a statement made by a senior forest officer during a discussion on fire-protection (*vide* the *Indian Forester* for May 1896). "In Forestry, in our view, it is the mature opinion of experienced professional men that is more

valuable than statistics." The argument turned on the question of collecting statistics, but no one took exception to this remark, and it was in fact endorsed by other officers. Yet how are sound opinions to be formed if they are not based on statistics? It is a matter of common knowledge that officers of all grades, some of whom have spent the whole of their service in Burma, have wandered in and out and round about these teak forests, and have formed strongly pronounced opinions concerning the growth of teak, but these opinions are based on *impressions* and not on evidence, and the fact that these opinions are so contradictory is a proof that they are unreliable. I recently noticed a case which shows on what slight evidence forest officers form their opinions, and yet how confidently they maintain them. In the January 1907 number of the *Indian Forester* Mr. Nisbet stated that reproduction of teak could be successfully assisted at the time when the bamboo flowered. He apparently based his conclusions entirely on a small experimental sowing which was made in his first year of service, and which was carried out by a native subordinate and never inspected by him at the time. Yet he spent the whole of his service in Burma and as Divisional Officer and Conservator must have had ample opportunities for studying the question. His article occasioned no surprise as we are accustomed to find in records opinions still more strongly expressed, although they are not based on an atom of evidence. On the Pegu Yomas which comprise much the finest teak forests in Burma or in the world, the dominant bamboo is *Bambusa polymorpha* which flowers gregariously at rare intervals, at most twice in a century. It is believed that it is only at these periods of flowering of the bamboo that regeneration of teak has the slightest chance of success. Schemes have therefore been prepared to carry out most elaborate works, involving large sums of money and much labour, when this bamboo flowers. It would be a very simple matter to ascertain definitely whether this theory is correct, as the examination of a few stumps of teak on which the annual rings could be counted would determine whether the ages of the existing growth of teak corresponds to previous periods of flowering of bamboo, the last of which was

known to have occurred in 1852. Also patches in which other bamboos have flowered are frequently found so that experimental sowings of teak could be made to ascertain whether these works would meet with success. Yet these precautions have not been taken, and not the slightest effort has been made to obtain any reliable information on the subject, although this would present no difficulties and cost very little money.

There has recently been considerable discussion about the effect of fire-protection on teak forests in Burma. Yet although we spend three lakhs of rupees a year on this work little seems to be known about the subject. Yet it would be simple to clear up all doubt in a single year and at a very small cost if evidence were collected in a scientific manner. Enumerations could be made in various types of teak forests and the damage by fire noted. The collection of these statistics would be largely mechanical and they would not therefore be affected by personal prejudice or imagination, and the results would not be accepted unless approximately similar results were obtained in every case. The value of the damage done could thus be ascertained for each type of teak forest and contrasted with the cost of fire-protection, Similarly the effects of fire-protection could be calculated by making enumerations in areas that are fire-protected and not protected but otherwise similar.

I should like to mention other points on which there is at present great doubt and to describe the experiments which would produce the necessary proof, but this would take up too much space. One experiment or one set of statistics is by itself of little use as figures are frequently vitiated by peculiar and exceptional circumstances, but if the same experiment is carried out repeatedly and if the same results are obtained in each case, there is, I think, no gainsaying the evidence, and such facts, so proved, lead to the elucidation of other and more obscure truths. Much could be done by divisional officers were a programme of experiments prepared, which would not require much labour to carry out, and were arrangements made to carry out the same experiments simultaneously in several divisions where the conditions are similar,

and it would be well worth while placing an officer occasionally on special duty to collect a few useful statistics.

It is apparently very difficult to realise that it is advisable to study the growth of trees scientifically, but in Burma our vacilating policy in such matters as fire-protection, teak taungya plantations, and improvement fellings, and in England and the Colonies the general lack of success in the management of the forests may, I think, be attributed to the fact that no effort has been made to study the growth of the trees cultivated. We read in the translator's preface to the Elements of Sylviculture by S. Bagneris that "the State forests in that country (France) have now been worked on some sort of a regular system for nearly 200 years and during the last 50 years of this period the special wants and habits of forest trees have been made the subject of patient and intelligent study." It is in fact only during the last 50 years that the methods of treatment have been brought to their present state of perfection and that those forests have proved such a success financially; and this is the result of this patient study. We too manage our forests on "some sort of a regular system," but I hope it will not be 150 years before we grasp the fact that we too must make a patient study of our trees and forests. My hope is that even in my time I may see the dawn of Scientific Forestry in Burma.

H. C. WALKER.

FIRE PROTECTION AND NATURAL REGENERATION.

Barajhar sal forest, in the Buxa Forest Division of the Eastern Bengal and Assam Circle, is situated 14 miles south-west of the Alipur Duar station on the Cooch Behar State Railway on the border of the Bhutan Duars and is intersected by three streams running north and south.

2. The forest is a mixed one, the dominant species being sal in the higher region, and inferior species more or less valuable in the low tracts. The old mature sal trees are mostly bad, being crooked, unsound, and full of burrs. The trees on the northern and the eastern aspects are the straighter and better developed. The soil is light, deep and moist. The surface soil is devoid of

underlying rocks, more or less undulating, full of natural mounds and of bad drainage.

3. Fire protection was introduced in the year 1879-80, since when the forest has generally been successfully protected. The result of fire protection has been to encourage evergreen undergrowth and weeds, and though sal poles of all ages from 6″ diameter and over are scattered throughout the forest, those below that diameter are conspicuous by their absence. Assuming the annual diametrical growth to be ·2″ (as calculated by the late Mr. Hatt in his Working Plan Report of the Division) the natural reproduction has been stationary since the time that fire protection was introduced. During the marking of sal trees under selection felling, the writer has observed that though saplings are conspicuous by their absence, seedlings are found scattered all over the more or less light canopied forests, but they are entirely absent in places where the undergrowth is thickest and shade darkest, notwithstanding the presence of mother trees. It has also been observed that the growth of the seedling is more or less vigorous in proportion to the light it receives. From the above, the question naturally arises why then are there no saplings in the forest when poles and seedlings are no twanting? The mother trees have been known to bear fruits more or less in the intervening years besides those in the special seed years. The seed cannot all have been infertile. The conclusion, therefore, is that the seedlings, as they germinate, die every year from the baneful influence of intense shade and of the drippings from the low crowned weeds and shrubs overhead, for the growth of which fire protection is responsible. Before however condemning fire protection wholesale, it is only just that the advantages gained by it should be stated which may be summarised as under so far as they affect the natural reproduction of the forests :—

(1) Even if natural regeneration can be obtained without fire protection, it is preferable to protect the forests from fire if possible. Any disadvantages which arise from fire protection only affect the forest gradually and can be remedied as they arise.

(2) Fire protection adds to the soil organic manure which is a necessary nourishment for the tree growth as soon as the seeds germinate and their roots penetrate into the soil.

(3) It has been seen, as stated before, that except in deep shade, fire protection does not hinder germination of seeds but seedlings die subsequently for want of light, etc. This defect it is the legitimate duty of the Forester to remove.

(4) Another disadvantage in the fire-protected area is that where shade is intense, seeds do not germinate at all. It is the Forester's duty to remedy this by removing the shade sufficiently around the mother trees and by wounding the soil if necessary. These operations would not be very expensive if the alternate coupe system be adopted. Considering the importance of the work which the writer believes to be the only means available to attain regeneration with any prospect of success, it should be specially provided for now that the large surplus of forest revenue is the talk of the day. From the year 1905-06 a sample plot of half a square mile has been started in the Barajhar sal forest to give the seedlings sufficient light by cleaning around them, and though the operation is only in its infancy, it is making its presence felt everywhere within the area as the seedlings seem to be giving up their lethargic condition.

4. Now the question arises if these difficulties can be got over more easily and in a less expensive way in unprotected areas. In the small areas of sal forest in the waste lands around the Buxa Forest Division, not subject to fire protection, it has been seen—

(1) That seedings and saplings are conspicuous by their absence.

(2) That the undergrowth consists of a dense mass of grass which kills the seedlings as soon as they germinate and a great proportion of the seeds never reach the

soil at all on account of this dense cover of grass. Besides suppression, which is common in both the protected and the unprotected areas, the additional obstacle here in the way of the natural regeneration is the destruction of seeds by fire which generally passes over the forest after the seed-fall, hence the entire absence of seedlings in the unprotected area. The only advantage that can be obtained by the burning of sal forests, as seen in the waste lands here, is that as sal poles have more fire-resisting power than other species, the sal poles gradually occupy the soil entirely and in consequence forests are seen entirely pure which phenomena is rarely seen in the protected forests where removal of suppression is an additional task imposed upon the forester until the sal pole can erect its head over all around it. But it is doubtful if this advantage will be lasting, inasmuch as it has been seen that fires occurring at midday in April and May often kill mature trees thus making the forest more and more open. The more the forest becomes open, the more the grass grows and the more virulent the fire becomes until the forest is turned into an open glade with stag-headed sal trees standing few and far between and long dangerous grass as undergrowth. It may be urged that all these defects in the unprotected area can be got rid of by judicious "light burning" But it is futile so far as the Barajhar sal forest and forests of like nature are concerned. They will not take fire until leaf-shedding is in full swing, *i.e.*, from the middle of March to the end of April. Even then at night they will not burn and in the day time when strong winds are blowing, light burning is impracticable. Even if it can be managed, the burning of the undergrowth does not serve any useful purpose, there being no seedlings underneath, and the preservation of it is necessary to protect the soil from excessive sun

light. It will not be out of place to summarize the advantages and the disadvantages of the results in fire-protected and unprotected areas so that authorities more competent to pronounce opinions on the subject may judge their merit at a glance.

Fire-protected Area.	Unprotected Area.
1. Undergrowth, weeds and shrubs.	1. Undergrowth grass.
2. Seeds germinate almost everywhere but die subsequently from bad drainage and want of light.	2. Germination of seeds is uncertain, except when fire passes before seed fall.
3. Seedlings manage to exist here and there in more or less open places.	3. Seedlings rarely seen as suffocation by grass is complete everywhere.
4. Saplings almost absent.	4. Saplings almost absent.
5. Sal poles heavily suppressed.	5. Sal poles are almost free from suppression.
6. Cleaning and weeding are necessary to improve the condition.	6. Cleaning around the seedlings is urgent to free them from suffocation.
7. The disadvantages are remediable.	7. The disadvantages are not remediable until the method of operation is changed.

5. In conclusion, it is not out of place to try to solve here how these forests existed in bygone years when there was no fire protection. The probable solution is that the frequence of fire has increased with the increase of population. In years past population was sparse, hence fire was rare; in consequence forests managed to exist. Now with the increase of population, conditions have changed hence special measures are necessary to keep the forests safe from fire. *Protection from fire is the only sure means of* improving the forests, especially the regeneration which in the writer's humble opinion is not practicable in any other way.

SUKH LAL DUTT,
Forest Ranger (on leave),
E. B. & Assam Circle.

KANKURIA:
Dated the 15th August 1907.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

THE CARE OF FIREARMS.

Not all of us devote to the cleaning of our guns the time and care the operation demands: and the process is one which probably few men really understand, depending, even if they go so far, upon some oil or preparation obtained from the gunmaker. We would not be understood as suggesting that such preparations are unworthy of confidence, but that their proper use is seldom understood by those who employ them. This is a mistake: a greater mistake in these days of nitro-compounds than it was when the use of black powder was universal; for with all its superiority the nitro-compound is guilty of far more serious fouling than was ever black powder, and its effects upon the barrel are much more difficult to counteract. We cannot, as our fathers were safely able to do, follow out the simple prescription of the armourer—use hot water *ad lib* with a rag wound about the jag and work the tool piston wise till "the water runs out clean and pure at the touch hole:" this mode of cleaning did very well in old days, but the cleaner might use all the water in the compound well before he succeeded

in removing the peculiar *chemical residue left by a day's use of* nitro powders. Too many of us succumb to temptation and leave the cleaning to the patient and willing if unskilled hands in the back verandah : a native servant who can be trusted to clean a gun properly—even a rifle—may be found occasionally, but such treasures are rare and it is not wonderful that they should be when so few masters are versed in the art of gun cleaning themselves. The only firearms that regularly receive the meed of attention a good weapon deserves are probably match-rifles on whose accuracy perfect condition of the interior of the barrel depends. Some sportsmen make a point of cleaning their rifles themselves when out in the jungle, or on the hills, but most, we imagine, leave the business to a servant or shikari and content themselves with cursory inspection afterwards. If that cursory inspection reveals a bright interior it suffices : the gun or rifle is considered clean and *the owner is satisfied*. A *speck* or two of corrosion in a smooth bore may appear of small account, and provided the speck does not increase in area it will probably do little to affect the "pattern" to which experts attach so much importance : but inasmuch as the effect of a speck or specks upon the passage and distribution of a charge of shot is impossible to gauge, these superficial flaws should at least be regarded as indications that the cleaning bestowed upon the barrels in the past has not been all that they deserve.

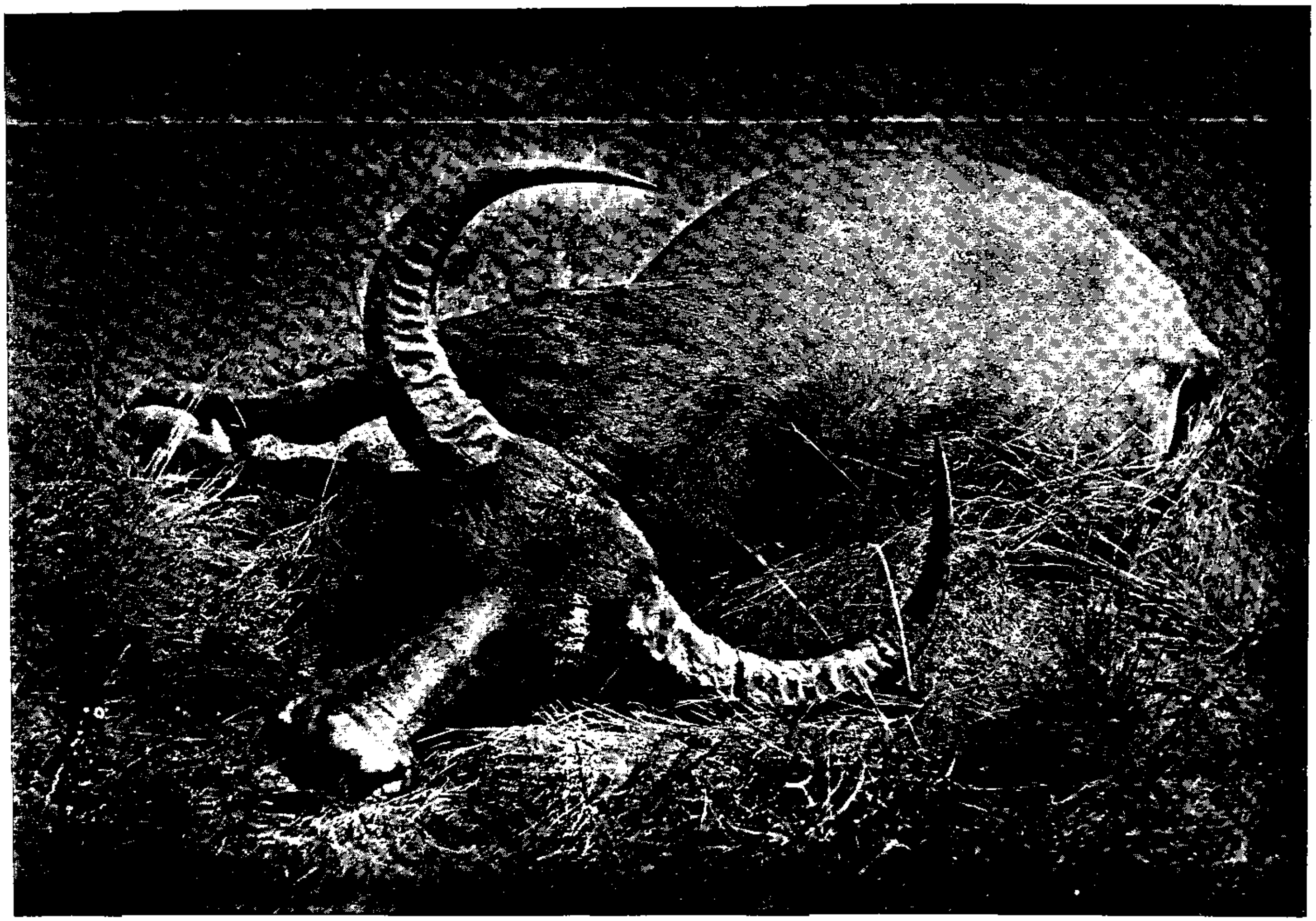
Needless to say the *fouling of a rifle barrel, particularly when* nickel-covered bullets are used, is a thing totally distinct from the fouling of a gun barrel. An article in a recent number of that useful publication, *The Kynoch Journal*, deals with the former process of fouling in detail and deserves study by every man who uses modern ammunition : it was written primarily with an eye to the needs of the match shooting rifle from which many more shots are fired than from the game rifle : but inasmuch as the accuracy of one means success or the reverse at the target, while on that of the other the life of the owner may depend, it is surely needless to argue that the game rifle should be treated with at least an equal degree of care. In former days, we are told, the match rifle barrel might be depended on to last out a lifetime if properly

cared for : but since jacketed bullets and high pressure explosives have come into use "it has been found impossible to keep a barrel at its highest pitch of accuracy for more than a few hundred rounds." Moreover the "life" of a barrel is a curiously uncertain quantity : some rifle barrels will last out a thousand rounds without appreciable loss of accuracy, while others will show signs of failing after fifty shots have been fired. Loss of accuracy in either case is very generally due to the fouling which with modern ammunition has peculiarities of its own and is complex enough to require consideration at the hands of the chemist. The nickel-covered projectile travelling first leaves metallic fouling : behind it comes a blast of white hot gas under enormous pressure depositing both solids and acids atop of the metallic fouling. The next shot deposits a new film of metallic fouling on that and the new layer of fouling from the powder ; and as if these were not enough there is mingled with them "the steel washed away from the breech end together with the tarry matter deposited by the combustion of the vaseline and other hydro-carbons of the explosives," the whole forming a spongy film of great tenacity—as we know to our cost when we undertake the job of cleaning. When removed by chemical re-agents this fouling is found to contain copper, nickel, carbon, acid and iron in varying proportions ; and the worst enemy of the barrel among these constituents is the acid : that is the "active rusting agent," and it is so incorporated with the solid matters that it cannot be reached by the application of an alkali.

As every one knows, a barrel may be wiped and rubbed until it looks perfectly clean, and yet if left for the night is found to be foul when again examined. The barrel has not been properly cleaned : but it is perhaps consoling to be told that as a general rule barrels cannot be successfully cleaned by a single operation. This knowledge relieves us of a certain sense of chagrin and should serve to exonerate the servant who has produced the desired, but deceptive, brightness of the barrels. The apparently clean barrel "comes up" after some hours, and shows dull and dirty : this is the condition that indicates necessity for another thorough cleaning and that thorough cleaning must be repeated until the barrel no

longer dulls or " comes up " after rest. Barrels cleaned with rifle oil (*i.e.*, oil and alkali) or with mineral jelly such as vaseline *always* " come up " for several days, usually for a fortnight. The use of wire gauze is useful in clearing the bands and grooves of metallic fouling but does not prevent rust, the great foe of the rifle barrel. The action of rust being brought about by chemical changes, the corrective is to found among chemicals: no actual preventive of rust has been discovered and in the very nature of things it seems idle to hope that any preventive will be devised that is applicable to the interior of barrels.

The expert, from whose writing we quote, tells us that he tried the effect of putting a little powdered ammonium carbonate into the barrel after firing, with no other attempt to clean, and " the effect was all that could be desired. The surface of the metallic fouling, which consists chiefly of copper, turned blue, in consequence of the action of ammonia mixed with air : but the steel of the barrel remained unchanged." After a time, however, when the barrel had been wiped out and oiled, rusting set in and made rapid progress. Again chemical knowledge was brought to bear and it was realised that the ammonia gas had combined with the acid products of firing imprisoned in the metallic fouling and " formed a hygroscopic nitrate which took up the water of the air and began a cycle of rust on its own account." This discovery made the antidote was obvious : it was simply to wash out the barrel with plain water, after using the powdered ammonium carbonate, and dry it thoroughly before oiling. That done the cleaning by this method proved quite successful. It is one of the penalties of using highly finished weapons and ingeniously contrived ammunition that the matter of cleaning should become more important and less simple : but when the chemist comes to our rescue to undo the evils he himself has contrived we have no cause of complaint against him.—*The Indian Field.*



WILD BUFFALO.

Photo. Meghl. Dept., Thomason College Roorkee.

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FORESTRY AND AGRICULTURE.

In India during recent years there has been a great advance made in the direction of agricultural education and research. The Agricultural Research Institute at Pusa has been sprung into existence, agricultural colleges have been started in all Provinces, and now we believe that a separate Agricultural Department is about to be formed. So far, therefore, it seems that agriculture is receiving the attention that it deserves, and there can be little doubt that sound progress will result. It is, however, very surprising that so little reference has been made in Indian agricultural propaganda to the enormous benefits that agriculture may derive from suitably situated forests. This surprise greatly increases when we come to consider that a country like Canada, which up to a few years ago practically neglected scientific forestry, has conducted experiments at the Central Experimental Farm at Ottawa, during the past twenty years, to prove the inestimable benefit that judiciously-arranged forests are to agricultural crops. Mr. W. T. Macoun, the Horticulturalist at the above Institution has

published an instructive article in the *Canadian Forestry Magazine* for June 1907 entitled "Some Questions Relating to the Establishment, Maintenance and Improvement of Farm Forestry." This paper gives agriculturists in India much food for thought. The whole article should be read by those who are interested in the subject, but it is necessary here to quote the following:—

"There is no time in the history of Canada when the farmer's wood supply has meant so much to him as at the present time. The increasing price of lumber, the growing scarcity of wood for fuel in the older settled parts of Ontario, and the natural scarcity in some parts of the prairie provinces, the uncertainty of the supply of coal which reached an acute stage this winter, and its high price, combine to impress upon the farmer as never before the great importance of maintaining and producing a supply of wood which will be ample for his various needs, and which will make him as independent of the outside world in this respect as he *is in the matter of food.*"

The forest experiments at the Experimental Farm have been made with the object of not only proving the beneficial effects of forests on farming, but in order to disseminate the knowledge of how forests to meet the farmers' needs can best be propagated. So far as is generally known very little on these lines is being done in India, but we hope that the matter will be taken up at the Agricultural Research Institute and at other suitable centres in the various Provinces.

One of the first things in India which strikes the forest-trained eye is the enormous area of uncultivated or unculturable land which serves only to give a bare existence in the form of grazing to herds of, for the most part, a poor class of cattle. Compare this, with a country like Alsace, in which it is hard to find any unutilized land. Everywhere forest is to be seen commencing at the very edge where the fields and meadows cease. This seems the ideal which should be strived for.

As long ago as 1893 the eminent agriculturist, Dr. Voelcker, who was specially brought to this country to report on agriculture, strongly recommended "*the creation of fresh 'Reserves' of wood,*

fuel, etc. ('Fuel and Fodder Reserves'), primarily for agricultural purposes." Yet how much has been done in this way? The possibilities in this country are boundless. The areas not under cultivation are enormous, and these areas practically receive no attention or treatment. Supposing that they were gradually afforested and made into Fuel and Fodder Reserves as advocated by Dr. Voelcker, how great the advantage would be! Dr. Voelcker says: "The task of doing this (*i e.*, increasing the supply of wood, more especially of fire wood) is clearly beyond the reach of the people, and it is to Government that they must look for help. It is possible in some cases the people will follow, in a small way the example set them, but the duty is one which the Government must take upon themselves, just as they have done that of the supply of water."

It will be instructive to try and imagine what India would be like, were all uncultivated land properly afforested and treated systematically as Fuel and Fodder Reserves. The benefits to agriculture of a good supply of timber, fuel and fodder ready to hand, are obvious. Not quite so obvious, but quite as much a fact, are the benefits which such forests would give in the improved water supply and insurance against droughts, floods and famine. It may be remembered that a few years ago letters appeared in the *Pioneer* deprecating the fact that, although scientifically trained men all over the world are aware of these influences of forests, the Irrigation Commission and the Famine Commission passed over the subject, we believe, entirely. It is time that agriculturalists turned their attention to this most important subject. In the first place let an officer, trained in forest science, be appointed to the Agricultural Research Institute in order to conduct experiments similar to those being carried out at the Central Experimental Farm, Ottawa, and to disseminate the knowledge so gained. Native officers for conducting similar experiments at provincial centres could be trained by him or at the Imperial Forest College, Dehra Dun. In a very short time it would become known which species are most suitable for the various soils and localities, how plantings or sowings can best be done, and the many other facts

which must be ascertained before such a great enterprise could be undertaken with any certainty of success.

Further, it would be ultimately necessary to have some officers trained in scientific forestry appointed to the Agricultural Department in each Province, to encourage and inspect any works which might be undertaken in accordance with the results attained by experiment, and to give advice concerning the selection of areas for planting, the best way of conducting the operations and the management of the areas afforested.

It often appears that District Boards are in straits for money. Here there is a work that might be taken up by them, and which in time would not only render them independent of other income, for the ultimate revenue would be so large that a district in which this work was accomplished would eventually have probably more than sufficient income from this source alone. In many towns and villages in several countries of Europe, the revenue from the communal forests is so large that after paying all rates and taxes due from the community, it is possible to pay out the balance as a bonus to the inhabitants. Why should not such results be eventually attained by District Boards? Of course, there are many difficulties to be faced, *i.e.*, difficulty in acquiring the land, in protecting it while the plants are young, and many others, but it is not to be expected that an important work like this for the general good of the community can be accomplished without any trouble.

The restriction of grazing will be another very real difficulty, though by no means insurmountable. In some parts it may be found possible to grow species which will soon grow above the reach of cattle, in others it may be necessary to gradually educate the people to stall-feed their cattle, and to keep hay stacked for their yearly requirements. The cultivators will soon learn to appreciate the value of the manure, which will be saved from burning, by the plentiful supply of fuel resulting from the afforested areas.

The beneficial influence of forests in promoting, retaining and regulating an adequate water supply have been briefly referred

to. We hope in a future number to discuss this matter more fully.

One more point regarding the relations between forestry and agriculture, it is necessary to mention. The best possible way to restore the fertility of the surface soil where it has been rendered barren or nearly so by cultivation for an extensive period is to put it under forest which does this work more thoroughly than anything else will. It is well known that cultivation if carried on long enough, without a great deal of external addition in the shape of manure, gradually causes the surface soil to become sterile, as far as farm crops are concerned. It is also well known that the most fertile soil obtainable is that from which forest has been recently cleared. This indicates also an interesting ultimate possibility. When the present uncultivated lands have all been afforested in any one part a system might be introduced, as fellings took place, to give up for cultivation land with really good soil, and to afforest other land which in the meantime had become worthless for cultivation. This, however, is an [almost Utopian idea, for it will be such an immense period of time before the work of afforesting the present uncultivated areas is accomplished.

SCIENTIFIC PAPERS.

SOIL FERTILITY.

BEING EXTRACTS FROM *FARMER'S BULLETIN NO* 257 ISSUED IN 1906 BY THE U. S. DEPARTMENT OF AGRICULTURE.—(*Contributed.*)

The cause of what is known as soil fertility still forms the subject of investigations in several countries and some of the conclusions recently arrived at in America are not in accord with our hitherto accepted view of the subject. But these modern conclusions, the result of prolonged scientific observations and experiments will, it is hoped, place us in a position to solve the problem of soil fertility in regard to Indian forestry with more certainty than has hitherto been the case.

Plants Excrete Toxic Matters.

The most important fact bearing on soil fertility, which has been brought to light by recent investigations, is that the plant throws off certain organic matters into the soil which are either in themselves highly injurious to plant growth or become so by bacterial or other action. That there are what are called toxic or poisonous materials in the soil can be proved. Many instances may be quoted in which a mass of unoxidised sub-soil when incorporated in the soil has been found to have an injurious influence on its fertility and this cannot be explained by any other supposition than that the sub-soil must have contained some poisonous matter. Further, that toxic materials are formed in the soil and that what is poisonous to one crop is not necessarily so to another, is shown by the beneficial results obtained by adopting the system of rotation of crops. Take, again, a common case where the growth of grass is injuriously affected under a tree. The explanation hitherto given for the sparse growth of grass in this case is that the shade of the tree and its greater power of absorbing water and plant food from the soil prohibit the normal growth of the grass, but shade cannot always have any very great influence on the growth of grass for it may be noticed in the case of a tree standing in a lawn, for instance, that the injurious effects of the tree on the grass are as marked on the sunny side of the tree as much as on any other. Further, other kinds of trees, larger and having even denser shade, may be found not to affect the grass in the same way. With regard to the greater absorptive power of the tree which is supposed to account for the starvation of the grass, it may be remarked that the most unsatisfactory growth of the latter is in the vicinity of the trunk of the tree just at that place where the tree draws no moisture or plant food from the soil, and further, that even when the moisture and plant food are supplied to the soil artificially, it improves the growth of grass in no way. The only explanation which can be suggested as satisfactorily accounting for the injurious effects of trees on grass is that the grass is poisoned by the leachings of the trees which contain the excreta from their

bark and limbs and by the toxic substances thrown out by their roots.

It appears, therefore, probable, indeed almost certain, that the plant throws off into the soil certain substances which, unless they are removed or are rendered harmless by oxidation or other means, have a deleterious effect on the life of plants. These toxic substances have not yet been isolated as they, like the ptomaines or the tox-albumens in decaying meat, are difficult to separate and study. All that is known about them is that they are highly poisonous to plant growth, are all more or less easily changed, easily broken down, easily destroyed and easily absorbed by the soil.

Fertility and Crop Production.

Fertility is a property inherent in the soil and may be defined as the capacity it has when in good condition for producing abundant crops. It is the chief, though not the only, factor in crop production Plants for their growth are dependent on exactly the same conditions as are animals, they require air, drink, food and a healthful home as much as the latter. Thus a soil will be fertile only when it can successfully perform the following four principal functions :—

(1) It must be able to supply oxygen to the plant roots.
(2) It must maintain sufficient moisture for the needs of plants.
(3) It must maintain the necessary elements of plant food.
(4) It must be able to dispose of any substances present in it which may be injurious to the growth of plants.

Effects of Cultivation on Plant Respriation.

It is a well known fact that the plant breathes mainly through its leaves, but it has been found that for the healthy growth of the plant there must also be a supply of oxygen around its roots. It is not exactly known in what way the oxygen is absorbed by the roots, but there is absolutely no doubt that it is indispensable to them. This absorption of oxygen by the roots cannot be advantageous to the plant unless certain noxious gases which are

present in the soil and which may either have been given off by the plants themselves or formed by bacterial or other action on their remains or excrement, are removed from the soil. In the light of these facts it is easy to see the effects of cultivation and stirring of the soil on its fertility and how these operations are necessary for the best development of crops. The process of cultivation and stirring has, besides others, the following important uses :—

(i) It introduces air into the soil from which the plant roots take in the oxygen required by them.

(ii) It removes all gases which are poisonous to plant growth. *Plants have been found to be exceedingly* sensitive to the action of gases and the influence of some gases on plant roots is extremely fatal. The ventilation of the soil is necessary for the healthy growth of plants.

(iii) It may also serve to oxidise the deleterious organic matter excreted by the plants, thus securing to the crop proper sanitary conditions and possibly adding to the actual fertility.

The Drink of Plants.

It has been hitherto generally believed that it is always through capillary action that the water of the soil with the plant food dissolved in it moves up constantly to the plant roots. But it now appears probable that the plant seeks the water and not the water the plant. Leaving out of consideration the rapid motion of water by capillarity through saturated or extremely moist soil, it has been found by measurement that in a moderately dry or fairly moist soil the rate of movement of water is too slow to be taken into account as regards the needs of plants. If a tumbler half full of soil containing an excess of moisture is filled up by putting some dry soil on the surface of the moist and then covered to prevent evaporation and left to stand for some days, it will be found that there has been no appreciable interchange of moisture between the two layers of earth. The reason of this

is that the moist earth holds the water with such tenacity that the dry earth cannot, so to speak, pull it away.

The whole of the root is incapable of absorbing moisture and mineral matter from the soil. It is the tip of the root together with a small portion (about $\frac{1}{10}$ of an inch) of the root just back from the tip which can absorb water and plant food, its absorptive powers lasting for not more than 4 days. As the root grows, the absorbing portion of it constantly changes so that the plant is always sending its feeding roots into fresh regions of the soil.

In the light of what has been said about the slow movement of water and of the above noted facts, it can hardly be asserted that the plant depends for its food and drink on capillary action in the soil. In connection with the drink of plants it may be noted here that after the root has progressed and the tip has ceased to be of use in absorbing nourishment, it corks over, that is, it becomes covered with an impenetrable layer of what are called "balloon cells." This prevents the re-entrance of the excreted matter of the plant into its tissues. The excreted matter is taken in by the soil which has extraordinary powers for absorbing organic matters and prevents its circulation in the solution in which the plant feeds. Thus it will be seen that these effluvia or the excrements, though poisonous to any plant that may grow in the soil afterwards, cannot injure the plant that deposits them, and here may also be seen the importance of the exceedingly slow movement of the soil-moisture.

The Food of Plants.

In addition to the carbon which they derive from the atmosphere for their tissue-building, plants require potash, phosphorus and other mineral substances which we generally speak of as the plant food and which are derived from the soil. It has heretofore been generally believed that crop production tends to exhaust the soil of its available plant food, making it barren ; but American research on soil fertility shows that barrenness cannot be due to such exhaustion, but solely to the introduction into the soil by a crop of toxic matters which act injuriously on the growth of the crop which follows after.

The soil according to modern view is not, as has hitherto been the general belief, the result of the *decomposition* of the rock. It is *rock itself unconsolidated* and containing every thing originally present in the solid rock the action of "weathering" being simple *disintegration* with little or no decomposition of the rock-forming minerals. By means of a powerful microscope and other means of identifying small particles of matter, clays have been found to contain unaltered particles of minerals that originally formed the rock. The original minerals of the rock, then, exist in the soil as such, but in a finely-divided condition. They are not absolutely insoluble but dissolve to a slight extent in water—to the extent of about 8 parts of phosphoric acid and about 20-25 parts of potash per million parts of soil, so that they are soluble enough to furnish the plants with their requisite nutrient solution. All soils have, broadly speaking, all those rock minerals which contain phosphoric acid and potash, so that the composition and concentration of the soil moisture from which the plants draw their food, is approximately the same in all soils whether they are the sandy soils of the rivers or the sandy clays on the uplands. Thus all soils are fertile if fertility simply means the presence in the soil of the necessary elements of plant food in the form of solution.

Again after the nutrient solution has parted with some of its mineral matter to the plant, it is again restored to its normal strength which was already more than enough for any need the plant might have, by further dissolution of the solid mineral matter in contact with it. As regards the question at what rate this restoration of the solution takes place, it was found that the rate is as fast on an acre planted in ordinary crops as the demand made by the plant on the solution.

It will thus be seen that the barrenness of a soil cannot be accounted for by its exhaustion consequent on the demands made by the plant on it, even though it is a fact that plants will thrive better (why it is not known) when their nutrient solution is stronger than is actually needed by them, for, as said above, that solution is always strong enough for any demand the plant may

possibly make on it. Further it is also clear that the function of fertilisers which are so necessary for some soils is not, whatever else it may be, to supply food material for the plant to the soil. This view is confirmed by the farmer's experience that fertilisers do not always make the soil immediately productive.

The Meaning, the Function and the Methods of Fertilisation.

The poisonous excreta of plants thus may render the soil unhealthy for plant growth and unless, as said above, these toxic matters are removed or their injurious action counteracted, it is evident that after some time the soil may become extremely poisonous for vegetable life.

An "exhausted soil" therefore from this standpoint means only a soil more or less poisoned by the excreta of plants grown in it. Hence proper fertilisation would evidently mean the removal in fact or in effect of these toxic substances from the soil. This purification is effected in four different ways: (*i*) by aeration or direct oxidation, (*ii*) by rotation of crops, (*iii*) by judicious fertilisation with the aid of chemicals, etc., and (*iv*) by humus formation.

Aeration.—The process of aeration as mentioned before restores the soil to its original tone by oxidising the poisonous organic matter and changing it into some harmless substance such as humus. This is a slow natural process effected by sunshine, cultivation and stirring. A barren soil or a raw sub-soil might take about three years to become productive by aeration alone without the aid of manure or fertilisers. But this desirable change may be hastened as explained later by means of manures.

Rotation of Crops.—The rotation of crops, it appears, is identical in its effect on soil with fertilisation. The extensive experiments of Lawes and Gilbert go to show that a soil which is "exhausted" or poisoned by a long succession of a particular crop, so much so that it would refuse to grow that particular crop at all, is quite fertile for another kind of crop. The explanation of this is given by the fact that the toxic matters excreted by one kind of crop though poisonous for that crop may not necessarily be so to another kind of crop.

Lawes and Gilbert kept up the crop productivity of a soil for wheat unimpaired for fifty years by a four-year judicious rotation of crops without the aid of fertilisation, the yield being about the same as when wheat was grown continuously with the aid of fertilisation.

Hence it is evident that the rotation of crops maintains the fertility of the soil not only because of the fact that a crop is not injuriously affected by the excreta of the preceding crop, but it gives the soil sufficient time to dispose of the excreta of a particular crop so that that particular crop may again be advantageously grown in its due turn.

Fertilisation.—The injurious effects of toxic matters, it has been found, can also be counteracted by the addition of suitable chemicals or "fertilisers," and it is then possible to grow the same crop over and over again without decreasing the crop productivity of the soil. Lawes and Gilbert maintained for fifty years the wheat productivity of a soil by properly treating it with an elaborate mixture of phosphate, potash and nitrate. They also proved that in the plot where wheat followed wheat without such chemical treatment or "fertilisation" successively for fifty years, the yield decreased to a little more than one-third of the original output.

Fertilisers may be of many kinds. They may be mixtures of chemicals (phosphates, potash, nitrates, etc.) or stable manures or green manures. Their effect is not alike on all soils. It has been found that there are soils which derived no benefit or even a slight injurious effect from manure.

Much depends on seasons, on the nature of toxic matters which vary with the nature of the plants that deposit them and with the nature of the soils in which they are deposited, on the physical conditions of the soils and on its prior treatment, so that it becomes necessary to ascertain beforehand what kind of fertilisers would be useful to a particular soil for a particular crop. How this is to be done is explained later on.

That it is extremely desirable to examine a soil before-hand for its manurial requirements was proved by experimenting with a pound of soil in a peculiarly constructed small pot. After growing

six wheat plants in the pot and cutting them off after three weeks, the same number were grown in the same pot and it was found that they showed a very poor appearance as compared with the first plants. Chemical fertilisers containing the necessary elements of the plant food were now added to the so-called "exhausted" soil of the pot. They did not improve in any way the growth of the second set of plants after the first set was removed. But when finely chopped up cowpeas were thoroughly mixed up with the "exhausted" soil, the latter gave double the yield or double the size of the plants grown in the *fresh* soil. Thus in the case of the particular soil experimented upon what was required was not chemical fertilisers, but a manure containing organic matter. In this connection it was further shown that it was not the proportions of salts present in the cowpeas that improved this particular soil, but the organic matter present in the cowpeas. The action of the manurial organic matter will be explained presently.

The experiments above referred to, it may be remarked here, leave no room for doubt that what the so-called "exhausted" soils or the worn-out lands need is, not plant food but purification and cleansing.

Humus formation.—Humus is a very stable form of organic matter and has been found in its direct influence on plant growth to be quite indifferent—neither injurious nor beneficial. Indirectly, however, it is extremely useful for plant growth. In the first place it has important physical effects in improving the soil texture, in loosening it and enabling it to hold moisture. Secondly, it ensures in the soil a proper sanitary environment for the plant roots. A soil must be able to convert all poisonous organic matter added to it into harmless humus either by bacterial action or oxidation and if it cannot do it of itself, it must be enabled to perform this important function through the aid of manures. It appears that the organic matter of stable manure or green manure, which easily changes into humus, purifies the soil and facilitates the action of bacteria or oxidation in changing the toxic nature of organic matter thrown into it by the preceding crop. It is with this object, the purification of the soil for rendering it a healthful home for the

plant to thrive in, that all "fertilisers" or manures should be added to the soil.

A soil that contains and will produce humus, is a fertile soil and needs probably no "fertilisation." In this case it is not organic matter in any form, but the humus which is its harmless form that adds to the fertility of a soil, and it is on this account that black soils have been found to be more productive than light coloured soils which may contain as much or even more organic matter (not in the form of humus) than the others.

The Method of determining the Manurial requirements of Soils.

As pointed out above, it is extremely desirable that we should be able to know what kind of fertilisers are required by a soil. The following simple method has been recently recommended to obtain this desired information.

A little wire basket open at the top is made by riveting together the ends of a strip (10 by 3½ inches) of galvanised wire netting with about one-eighth inch mesh and forming the bottom by a disc of the same material. The top of this basket to the depth of about 1 inch is then dipped into melted paraffin once or twice, till a rim of paraffin is formed. It is then filled to within about half an inch of the top with the soil under examination, which should be in its best possible condition, that is, it should have about the right amount of moisture. Care is taken that the soil is well pressed down and any that projects through the meshes is brushed off. Other similar baskets are similarly filled up with the soil mixed up with fertilisers of different kinds and (if need be) in different quantities. Six seedlings of what it is desired to sow in the soil are then planted in a row to the same depth in each basket. The surface of each basket is then covered with clean dry sand to a depth of about one-fourth inch. The baskets bottom down are then dipped into hot paraffin till a hard layer of paraffin connected with the rim is formed round the baskets. They are then placed under favourable conditions of moisture, light and temperature. At the end of about three weeks the relative value of different fertilisers is estimated by making a

comparison of the appearance and growth of the plants in the different baskets. The effects of the different fertilisers may also be measured by cutting and actually weighing the plants by measurement of the transpiration during the period of growth ; but simply comparing the appearance and growth of the plants is perhaps easier and more practical.

The reason for sealing the seedlings up in such baskets is that otherwise the roots may project and by the effects of air on them a poor soil may grow equally good plants as a fertile soil.

It may be noted here that this method can also be used to determine whether a soil requires liming. The usual method of determining the acidic nature of a soil by means of litmus paper to see if it needs liming is not reliable, as it has been found that some neutral or slightly alkaline soils may redden the blue litmus paper. Blue litmus is a salt of an organic acid and it may be that the extraordinary absorptive powers of some natural or alkaline soils may so influence the bases of the organic acid as to split up the litmus and withdraw the bases. The organic acid thus left free reddens the blue litmus.

In spite of the fact that the method just described is not an exact scientific method, it is claimed for it that it is much more practical and efficient than a chemical analysis of the soil, and the claim in the light of all we have said on soil fertility and the function of fertilisers seems to be a perfectly rational one.

OXFORD, DEHRA DUN AND AFTER.

II.—(*Contributed.*)

The article which appeared in the September issue of the *Indian Forester*, under the above heading, is characterized by thoughtful moderation and by many fundamental truths, but something more definite is needed in the way of suggestions for giving effect to improvements which are so obviously required. In the following article another author will endeavour, if in more assertive language yet with an equal desire for veracity, to supply this omission.

We may well agree that the recruit, whether from England or Dehra Dun, stands only at the commencement of his forest education and that his preliminary training should have been devoted to enabling him to complete this education in India. We may also agree that the necessity for developing the scientific side of the Department is urgent and that unless this is done, future progress must be small ; and few will deny that unless forest officers specialize in studies congenial to the individual, the advance which every earnest forester desires will be inordinately delayed. The first step would then appear to be to ascertain why "the brains and capacity of every member of the Department are not utilized to the full extent" and why there is no "intelligent combination of all the staff," and, having discovered the cause, rigorously to apply the remedy.

Looking back in the past we realize that the recruit, when posted to a circle, was given little chance to continue his professional education ; he was at once employed in executive work and his responsibilities and duties increased with his years of service, but in quantity only, not in kind. He was as a rule discouraged from undertaking any scientific investigations for the reason that men were few and the work of the lumberer and salesman heavy. A few years of unsympathetic repression will go far to stay the development of any scientific interest in the young officer, and force him to conform to the pattern which his superiors have laid down as desirable, and which may perhaps necessitate the employment of all his vital forces in cutting and carting timber or fuel, while his abilities are guaged by low rates and high revenue.

But are matters invariably so much better at the present time when forest organization is approaching completion and when the necessity for developing the scientific side of the Department is realized by every worthy member of it ? And, if so, why do we still hear complaints of the want of the practical knowledge of the English or Indian recruit, and why do so few of either come forward to add to the literature of a service so sorely in need of it ? We must decline to believe that amongst those who yearly join the Department, there are none who have the ability and desire to

devote personal study to some branch of the profession they have elected to pass their lives in, and that being so, we are compelled to ask whether the malign influences of the past are not to some extent still at work, and whether superior officers yet sufficiently realize the fact that the education of the recruit is in their hands and that neither practical nor scientific foresters can come from the schools of India or England, but are made in the forests of the country to which their life's work is given.

The question of whether the field training of the English recruit should be undergone in England or India is yet for settlement, but this is a matter of small importance compared with that other of *how the recruit should be placed in a position to enter upon* his practical education in India and be encouraged to make a special study of any branch of forestry that may interest him. On whom must the responsibility rest that the young officer shall maintain a high standard of professional, scientific and even moral, efficiency? The answer must unhesitatingly be, on the Conservator under whom he works. Just as the tone of a regiment is taken from the Commanding Officer, so is the tone of the service in any Forest Circle taken from the *Head of the Department, and exactly* as a Colonel influences his officers to excel in regimental work, in scientific acquirements, and in sport, so must a Conservator remain responsible for the class of officer that grows up under his guidance.

But this is not all. When we acknowledge that the location of a small Imperial Research Institute and the publication by the Government of India of Forest Records and Memoirs are steps in the right direction, we must not forget that these are but examples set to be followed, and are not in any way to be taken as the conclusion of attempts to develop scientific forestry. They are but the expression of the policy of the supreme Government indicative of the lines in which forest progress must proceed. Had we indeed possessed these small advantages 20 years ago, as we might have done, we should no doubt be far more advanced than we are now, but at this present stage of forestry in India they cannot avail us *unless they are repeated in every Province* in India under the direction of the Conservator, not necessarily with the titles

and surroundings suitable to an imperial model, but on similar lines, actuated by the same pressure of necessity which led to the establishment of the originals and justified by exactly a similar reasoning which has resulted in the establishment of Provincial Forest Schools throughout India, *viz.*, in order the more rapidly to disseminate a knowledge of the aims of forestry throughout the Department and amongst private individuals and to remove one of the most serious drawbacks to its extension.

Thus it is thought that in the present day it is the administrative officers of the Department who hold in their hands the future both of the general tone of the service as well as its scientific progress. It is they who can give leisure by reducing the drudgery of departmental exploitations and sales, by limiting their executive orders, by lessening the strain of clerical labour; who can encourage their officers in research and in recording its results; who can inaugurate their own Provincial Research Institutes and issue their own Memoirs and Records, who can draw out their own programmes of investigation, all modest in initiation but certainly resulting in the wished-for combination of the Forest Staff whether in communication with the Imperial Research Institute or not.

We live in the days of decentralization when it is futile to fold our hands and wait till the fruit of others' labours shall fall into our mouths. We must realize that the Imperial Forest Service is built up of many provincial cadres and that the tastes and enthusiasms of each depend on those of its chief, and that complaints of indifference and inferior work must be direct reflections on the administration of the circle. If we demand a high standard from our recruits and scientific efficiency from our Deputy Conservators, shall we not demand still more from our Conservators? Without doing so it is useless to talk of "intelligent combination of all the staff" in the immense areas entrusted to us and we shall still remain as children crying for the light that does not come.

The road leading to general forest education and research has been thrown open to us; let us look to our leaders for permission and opportunity to enter upon it and for guidance in the way we would all gladly follow.

THE TIMBER SUPPLY OF THE UNITED STATES.

BY R. S. KELLOGG.

(U. S. Dept. Agr., Forest Serv. Circ. 97, p. 16, *figs.* 2.)

This circular contains a discussion of the available timber supply of the United States and the length of time it will last at the present rate of cutting. A large number of statistics are brought together from different sources as to the annual output of forest products, the number cut, the geographical distribution of the total timber product, and estimates of the stumpage of the United States at various periods, together with a recent estimate of the stumpage of the Pacific coast.

A map is given indicating the general distribution and character of the original forests of the United States, which shows the natural timber areas of the country to be embraced in five groups of states, as follows: North-eastern States, Southern States, the Lake States, the Rocky Mountain States, and the Pacific States. In the two latter groups practically all the timber-producing trees are coniferous, while in the first three groups both conifers and hard-woods are found.

Four types of forests are produced in the Southern States. The swamp areas of the Atlantic and gulf coasts furnish cypress and hard-woods, and the plains from Virginia to Texas, southern or yellow pine. Pure hard-woods are found in the plateau encircling the Appalachian Range, while the higher ridges contain spruce, white pine, and hemlock. The Lake States still contain many hard-wood forests in the Southern portions, and pine, tamarack, cedar and hemlock in the Northern areas. The chief timber trees of the Rocky Mountain Forests are western yellow and lodgepole pine, and those of the Pacific Forests are Douglas firs, western hemlock, sugar and western yellow pine, redwood and cedar.

The author asserts that it is unquestionably safe to say that our present annual consumption of wood in all forms is from 3 to 4 times as great as the annual increment of our forests. A chart is given showing the course of prices of white pine, yellow poplar,

and hemlock since 1887 and of yellow pine since 1894. The most liberal estimate as to the wooded area of the United States places it at 700,000,000 acres, whereas it is estimated by others as low as 500,000,000 acres. From a table showing the extent and ownership of forest areas in this country it appears that only one-fifth of our forest area is in National or State forests, the remainder being either in private hands or likely to pass into private hands. It is estimated that the present cut of forest products requires at least 20,000,000,000 c. ft. of wood, and that under the present conditions of mismanagement, the average annual increment is less than 10 c. ft. per acre for the entire area, whereas an annual increment of 30 c. ft. per acre is required to maintain the supply of timber now consumed annually.

The bulletin concludes with several quotations from an article by Fernow on the financial management of forests in Saxony and Prussia with reference to the adoption of a settled policy of forest management, based upon the cutting of the increment only, without lessening the wood capital.—(*Experiment Station Record*)

CURRENT LITERATURE.

THE CANADIAN FORESTRY JOURNAL FOR JUNE 1907.—This number contains much interesting reading. In the first place there is a detailed account of the eighth annual meeting of the Canadian Forestry Association which was held in March last. From this account we see that the forest cause is now receiving a good deal of attention in Canada, and we may expect to hear of rapid progress in the next few years.

There is an interesting paper on the Forest Reserves in Quebec. Up to two years ago the Province had nothing in the way of forest reserves except the National Park. Now the reserves amount to the enormous area of 165,474 square miles.

A long article on farm Forestry by W. T. Macoun describes what has been done at the Central Experimental Farm, Ottawa, since 1887. From his observations during this period he endeavours to throw light on " Some questions relating to the establishment,

maintenance and improvement of farm forestry." The writer first explains what planting has been done. He says the trees were planted for the purpose of gaining information on a number of points among which being (1) rate of growth of the best timber trees on different soils, at different distances apart ; (2) as to how the growth of species compared when planted pure or mixed ; (3) as to the influence on the crops in the adjoining fields.

The author then goes on to discuss the questions as to : How and when should planting be done? What sizes and ages are most successful? May seeding be substituted for planting. Further he takes up the questions : To what extent is cultivation (of the young trees) necessary? How can the wood supply be improved? The relation of forest shelter to crop production. Where can young stock be obtained? What is the cost of establishing a plantation? We congratulate the writer on a most instructive article, and we wish that something on these lines was being done in India.

Another article is "The Beaver in its Relation to Forestry," by Philip Cox. This discusses the influences of forests on the water supply and points out what good work the beaver did in past times by holding up the water-supply from running to waste. The article is most interesting and is well worth the attention of those interested in forestry and irrigation.

Further papers are entitled : "Our Forests, Past, Present and Future," by Henry Roy and "The National Irrigation Congress."

Altogether this number of the Canadian Forestry Journal is an excellent one and contains many illustrations. We cannot do better than bring it to the attention of our readers. It is published quarterly by the Canadian Forestry Association and the subscription is one dollar a year.

FORESTRY AND IRRIGATION FOR SEPTEMBER 1907.—This number of the Journal of the American Forestry Association maintains its established high level of excellence. It is full of interesting matter, which, however, is of too extensive a character to be noticed in detail. The paper entitled "Effect of a Late Spring Frost in the South-West" by Frank F. Phillips, gives a great deal of information regarding frost and its effect on various species.

Other important articles are: "Debris from Hydraulic Mining," "The Norway Poplar," "Domesday Book for Oregon Waters," "A National Need" and "Forest Planting in Connecticut."

PRODUCTION OF RED CEDAR FOR PENCIL WOOD.—(*U. S. Dept. Agr., Forest Serv. Cir.* 102.)—Mr. White states that something like 315 millions of pencils are manufactured in the U. S. yearly. For the manufacture of these 109,000 tons or 7,300,000 cubic feet of wood are required, so that each day 300 tons or 20,000 cubic feet are used. By far the greater part of this wood is red cedar. Its softness, straight grain and freedom from defects render it peculiarly adaptable for the purpose and a suitable substitute has never been found. There are two species of red cedar, the Southern *Juniperus barbadensis* and the Northern *J. virginiana.* The circular in question is a monograph on these woods and describes the range, sylvical characteristics, reproduction, present logging methods and future management.

BRUSH AND TANK POLE TREATMENTS.—(*U. S. Dept. Agr., Forest Serv. Cir.* 104.)—This circular by Mr. Carl G. Crawford, Chief Officer of Wood Preservation, describes the experimental treatment of seasoned (telegraph) poles by the brush and by the open tank process. The latter is a new method developed by the U. S. Forest Service and promises excellent results in treating poles cheaply and effectively. On the larger number of poles the preservative was applied to the outside with a brush, allowing it to soak into the wood through its own power of penetration. All the different preservatives were tested by this method. The second method was to soak the butts of the poles in hot preservative in an open tank. In this method only one preservative, the dead oil of coal-tar was used. The bulletin then goes on to describe the processes, gives the results and cost, and compares the advantages of the two methods. By the brush method the average cost per pole was 29 cents in the case of creosote of which 7 cents stands for the oil. By the open tank process the average cost per pole with creosote (the only preservative used) was 67 cents of which 22 cents stands for the cost of oil. Mr. Crawford calculates that the added life of a pole necessary to repay the cost of treatment

with creosote by the brush method will be above six months and by the open-tank method one year. He further estimates that the added life by the brush process is three years. In the tank process three times as much oil was absorbed as in the brush treatment and the penetration was at least three times as great. If it results in prolonging the life of the pole in proportion to the oil absorbed, then it will be a very efficient treatment, and the economy of its use will be very great.

WHITE OAK IN THE SOUTHERN APPALACHIANS.—(*U. S. Dept. Agr., Forest Serv. Cir.* 105.)—This is a monograph by Messrs. W. B. Greeley and W. W. Ashe. The importance of the white oak is great since it is one of the most widely distributed hard-woods in the U. S. It is moreover most widely used and its annual cut of over two thousand millions of board feet is more than double that of either red oak or yellow poplar, its nearest competitors. The bulletin discusses in detail the Distribution and Present Stand, the Wood and its Uses, the Sylvical Characteristics and the Management.

EXPERIMENTS ON THE AVAILABILITY OF PHOSPHATES AND POTASH IN SOILS.—(*Memoirs Dept. Agric. India, Chem. Series, Vol. I, No.* 4.)—Dr. Leather in this memoir gives the results of many interesting experiments and makes comparisons between soils from various places.

STUDIES IN ROOT PARASITISM.—(*Memoirs Dept. Agric. India, Bot. Series, Vol. I, No.* 1, *Pt.* 2.)—Mr. Barber continues in this part his exhaustive investigation of the haustorium of *Santalum Album* describing the structure of the mature haustorium and the inter-relations between host and parasite. There are sixteen plates giving clear drawings to illustrate the text.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

BUFFALO TRACKING.

In parts where buffalo can be tracked on foot, they afford probably finer sport than any other of the numerous game animals of India. Unfortunately where they are most profuse in their distribution, *viz.*, in the plains of the Brahmaputra and Ganges, they inhabit almost exclusively marshes. In such parts they must be shot from elephants. Sportsmen, who have shot them in this way, state that the sport is poor, that the buffalo take little notice of the elephants, and allow them to approach within easy range. This is very different to the localities where they are found in the Central Provinces. Almost all the low lying land there has been taken up under permanent rice cultivation and the buffalo have had to retreat to the jungles. They select the most level and open jungle where there is plenty of grass which however in these parts, as a rule, does not exceed 4 feet in height. In the hot weather, water is only obtainable at intervals of miles, sometimes as many as ten miles having to be traversed from one water hole to another in ordinary hot seasons. Such is the locality for good sport.

The most difficult matter is to find fresh tracks early in the day. Given these and a couple of aboriginal trackers who are always available on the spot, the sportsman can make fairly certain of getting a shot at a 'buff' before nightfall. The tracking on hard ground is difficult but these wild men are wonderfully proficient. Follow the track they will, as long as they see their employer is keen. No turning back to camp for breakfast, no shirking the heat of the day, no thought about returning to camp at night, such maxims should be adopted, and these men will follow the sportsman anywhere. It is much better to take up the track of a solitary animal which is almost certain to be a bull than to follow a herd. In the latter case the bull is almost

always to one side at a little distance from the herd. It is most provoking after an arduous day's work to find, on coming up with the herd, that no bull is visible. The cows, if they have not already done so, are certain to spot the sportsman should he then try to stalk round to find the bull. But it would of course be advisable for any one who has never bagged a 'buff' to follow the fresh tracks of a herd, if he did not come across a solitary track first, as he might not find the latter, and there is always a chance of seeing the bull with the herd.

The tracking is most exciting. It is alone worth going any distance to see these wild men unravel the track. It may occur to some that the foot-prints of a huge beast like a 'buff' must be obvious to all; so they are in a damp soil, but in the hot weather the ground in most parts is baked as hard as possible. On such ground tracking is very difficult. The aboriginal, however, has inherited the experience of centuries. A pebble overturned here, a blade of grass severed there, a minute shaving of horn from the hoof or a few insignificant particles deposited from the cleft of the hoof on sheet rock, some herbage cropped, a twig broken, a dead leaf moved, all indicate to him, as clear as can be, the line the beast has gone. Besides this interesting unravelling of the track, there is to the sportsman, the more important question to be asked the whole time as to how long has elapsed since the animals passed. The best guide undoubtedly is the dung, the colour of which changes very quickly, but the wild men also invariably test its temperature with their toes. The degree of warmth and consistency is to them an accurate guide. Herbage cropped is next best. A piece of the plant grazed by the 'buff' should be picked and compared with a freshly broken piece, if the eye can detect no difference, it is certain, if the season is the hot weather, that the beast can have only just passed on. In the rains, the fractures appear fresh much longer. The third indication as to time is gained from any blades of grass, etc., severed by the hoofs. The degree of dryness and brittleness has to be noticed. If quite fresh, in a hot sun, the conclusion is obvious. With experience a regular table of times can be made out. In half an hour

a severed blade will be half dried, in an hour quite dry, in an hour and a half brittle and in two hours or more very brittle. This is about the case in full sun with a dry temperature of over 100 degrees in the shade; but the sportsman can easily on some off day find out the rapidity of the changes under the prevalent conditions by picking a blade of grass, exposing it to the sun and noting the changes every quarter of an hour. When tracking, the sportsman must be the whole time on the *qui vive* to sight the game. This is no easy matter, for the grass is often about 3 to 4 feet high and the stunted branchy trees found in such localities afford a great deal of cover.

The only real drawback to tracking is that the direction of the wind cannot be taken into account, and if the tracks go down wind, the 'buff' will as a rule get alarmed and go off before the sportsman gets within a quarter of a mile. However there is often no wind to speak of and the tracks of 'buff' which have not been alarmed seldom go down wind for any great distance.

The 'buff' is a cross-grained brute and has been known to charge unprovoked. Such a one invariably makes a detour and lies up at right angles to his own track so that he gets early intimation of any one following him and is ready for them. The sportsman therefore must keep a good look out to the sides as well as to the front. In many parts large areas of open forest get burned and result in a premature sprouting of the grass. In such places buffalo may often be found grazing in the mornings and evenings since green grass in the hot weather cannot be found elsewhere. In this case they afford a pleasant stalk, for when feeding they are not very wary.

If once the sportsman gets on to the fresh tracks of a good 'buff,' he should never leave them until he has obtained his shot. A lucky time when one often gets a chance is in the evening and it is therefore necessary to have no thought for getting back to camp for the night. In such a case, if the 'buff' has not been come up with by dusk, and one is too far from camp to return, the best way is to bivouac at the nearest water or village and one can then take up the tracks again early in the morning.

The best season for tracking and stalking 'buff' is at the commencement of the monsoon. The grass is then short and owing to the ground being soft, quick tracking is possible and when sighted the game can be approached without noise. The one drawback is that often when one is following an exciting track, a heavy downpour comes and obliterates all trace of it or makes the tracks appear stale, so that it soon gets lost. In the cold weather the grass and under-growth are generally very dense while in the hot season it is difficult not to make a noise as the grass, dead leaves and under-growth are so dry.

The question of rifles is an important one. I have in former days used all sizes of black powder rifles from ·450 bores to 8 bores. I found that a ·450 with a long hardened bullet for the first shot was the most effective, but it was necessary to have a heavy rifle, 8-bore Paradox for choice, in reserve for wounded bulls or in case of a charge. With a ·450 one must have the power to stay one's hand until an opportunity at a vital spot occurs, but it is useless shooting with any rifle at a big beast like a buffalo unless one is pretty sure of reaching a vital spot. Even with an 8-bore a 'buff' not wounded vitally is almost certain to get away.

It is because sportsman choose a heavy rifle like an 8-bore for their first shot that so many buffalo get away wounded and often die a lingering death. Mr. C. E. M. Russell* says: "The late Mr. Sanderson, a long time subsequent to the publication of his book, wrote to me just after he had returned from an expedition undertaken mainly in search of this game, telling me that he had lost half the 'buffs' which he had wounded though some of them were upon three legs and in spite of the powerful weapon (an 8-bore with a powder charge of 12 drachms) which he used in that trip."

This certainly is serious evidence against 8-bores, considering what a good shot Mr. Sanderson was. I believe it is a physical impossibility for a sportsman, fatigued as he often is, to shoot true

* Bullet and Shot in Indian Forest, Plain and Hill. By C. E. M. Russell, Thacker and Co., 1900.

with an 8-bore except at close quarters and even if he does, the penetration does not equal a ·450 M. H.

I found that the most effective rifle for 'buff' was the ·450 Martini-Henri with the service bullet. The bullet is so long that its penetration is greater than a ·450 express although the latter has a heavier charge. The momentum on the hinder part of the M. H. service bullet seems to drive it home with tremendous force. It is I believe a fact that of all English black powder rifles the penetration of the M. H. is the greatest. I have not been in a 'buff' country since the high velocity cordite rifles were invented. Undoubtedly now-a-days the ·450 high velocity or the nearest size which may now be imported would be the ideal weapon.

In the beginning of 1891 when I had been in the country for little over a year I was in camp with a brother officer in the south of the Central Provinces. He had never shot a 'buff', so we agreed that he was to have the first shot. We were only armed with No. 2 expresses (·500 bore) and hollow bullets. We soon got on the tracks of a herd and after tracking for some time came up with them in a patch of grass taller than usual. The bull becoming suspicious, came cantering towards us to see what we were. He stopped at about ten yards off with his nose protruded and horns back. My companion, L—, who could just see his forehead above the grass, aimed at it but the bullet must have glanced off at that angle. We followed him for two days but never got another shot.

A few days afterwards we arrived at a good place on the banks of the Indravati river. The first day we came on a big herd and L—got a shot at what looked like the bull. He, however, had aimed in the centre of the body behind the shoulder instead of low. The animal went off and we followed it for hours. Eventually we came on it in a tall patch of shrubs and grass at about 5 yards distance. It was in a very bad way and took no notice of us. A shot from L—behind the ear finished it. We then found it was a cow. The colour of bulls and cows is the same but the horns of the bulls are shorter and thicker than those of cows. It is easy to tell the difference in some positions; in others when

the horns are laid back and the ears appear mixed up with them, causing them to appear very thick at the base, it is extremely difficult. I have several times since made similar mistakes.

It was by then 2 or 3 o'clock. We had no water and were very thirsty. The Gond trackers discovered that the 'buff' was in milk and nothing would satisfy L— but that he must have some to allay his thirst. So the Gonds milked the dead beast into a bowl made of leaves and he drank it. He said it was very salt. In half an hour he was much more thirsty and had a bad time till we reached camp in the evening.

The next day we found the track of three bulls who were fraternizing together. We followed for 4 or 5 hours and came up with them in a glade. We could only see the hind-quarters of one at the further end about 80 yards off. It was my shot, but instead of waiting for a better chance, I decided to take the kidney shot, which I had been told was fatal. So it may be, if you can see where to aim, which is difficult on an uniformly coloured animal whose legs you cannot see. I judged where his hind leg was and aimed in front of it, about six inches below the back. In my excitement, (I was only a beginner), I let off both barrels and missed clean. The three bulls cantered out in the open and took a line straight down the glade to where we were. They were not charging, really, as they probably did not know where the shot had come from. L—, who was on my left some ten yards off, got a shot at about thirty yards but the bullet unluckily hit a horn. I stood in a clump of small trees, the only protection available. A few yards in front of me the bulls swerved and passed me six or seven yards on the right. I had loaded one barrel by then and blazed at the foremost as it passed me. It fell on its head and made a complete somersault. The other two, including the one whose horn was hit, went off. My bull, however, was only wounded and up he got to try to get at us. Luckily he could not progress. We each gave him both barrels in his head and down he went again. He got up several times and we kept on knocking him down. At last we thought he was dead but when we approached he got up again. This time he was turned

somewhat to our right and our bullets finished him. Twenty-three hollow express bullets had hit him. Thus we gained our experience never to use hollow bullets for such animals.

As we were not very far from camp I sent for my camera and took the accompanying photo of my first 'buff.' The bull was a fine one 16½ hands high, but the horns were not very large, being only 89½ inches, tip to tip round curve. The 'buff' in the Central Provinces, where they inhabit jungle, do not grow such long horns as those that live in marshes. The continual knocking against trees tends to make them curve inwards.

After this I tried in turn, a 12-bore taking 9 drachms, a 10-bore Paradox taking 8 drachms, and an 8-bore taking 14 drachms but I lost several bulls. Then I was recommended the M. H. and the service bullet. I tried it and dropped the first 'buff' I shot at with one bullet and have repeated that several times since, but with such a small bore it is a *sine quâ non* to shoot only when one can see a vital spot.

When wounded, 'buff' must be followed with great caution They have a habit of shamming death. Should the unwary sportsman approach such a one, the 'buff' is up and on him before the rifle can be raised. 'Buff' do not toss like a bison but use one horn at a time to gore with. A charging 'buff' is a difficult beast to shoot as he holds his nose up and horns back until he gets within a few yards, then he lowers his head and can be killed by a bullet in the forehead. The sportsman must, however, leap to one side as the impetus often carries the animal on. Too much care cannot be taken in approaching big game when supposed to be dead. One good rule is always to advance towards the tail end, so that if the beast gets up one has the chance of a good shot as he turns round.

A good plan when following a wounded bull is to have a man up a tree on each side to keep a look out ahead. When the sportsman and trackers reach the next trees, the sentinels can come down and climb these, and so on. They will often discover a beast lying in the grass that cannot be seen on foot until quite close. One bull I had shot at with a M. H. went off as if nothing

had happened. I knew I had hit him well. We followed the track and I had men up trees as described above. As one climbed a tree near me, he gave a yell and said "Here he is." We could see nothing and strained our eyes in all directions. He then said "He is dead, near your feet," and there, two yards in front, he was lying stone dead, but we could see nothing as the grass was so thick.

In 1896 I was transferred to a district where buffalo had once been numerous and had then been reduced to two; one old bull and a calf, six months old. Many sportsmen had tried for the wary old bull and I found that the trackers there had a regular system of taking out sportsmen with no intention of their getting a shot to kill the "goose that laid the golden eggs." With inexperienced sportsmen they meandered around, showed them tracks, at 11 or 12 o'clock said it was no good going on, and took them back to camp. With more experienced ones they would get them up fairly near to the bull and take care to give him notice to be off by breaking a twig or coughing. Coming from a 'buff' country I saw through their tricks and it was not long before I bagged the grand old fellow with one bullet from a M. H. His horns measured 102 inches from tip to tip and 20 inches in girth at the base.

The only remaining survivor was the ow-calf which now for company's sake attached herself to the tame herds which grazed in the jungle. I could easily have caught her then, but I had heard how liable buffalo are to die in captivity when young, so I conceived the idea of bringing her up in her natural surroundings. I instructed the herdsmen to take care of her when she attached herself to their herds and not to frighten her away. So she went on getting tamer and tamer for two years. When I heard I was to be transferred, I had her driven with tame buffalo to a place near the railway line. I offered her to the Zoological Society of London but they refused to incur the expenses of her passage. I then disposed of her to a neighbouring Rajah.

It is often supposed that wild buffalo differ very little from tame ones. This wild one I showed to many people and they were surprised at the difference. It stood 14½ hands when two and a

half years old, a good six inches taller than the full grown tame ones. The most remarkable difference is in the massiveness of the legs and the huge hoofs, which make the tame ones look quite insignificant.

PATHAR.

EXTRACTS FROM OFFICIAL PAPERS.

BURMESE FOREST LEASES.

GOVERNMENT ORDERS.

The *Burma Gazette* of the 14th September 1907 contains an important Resolution on Burma Forest Leases, from which we take the following particulars:—

As most of the present forest leases in Burma will expire in the course of a few years, the Lieutenant-Governor desires to announce beforehand, for the information of the firms engaged in the timber trade in Burma, the policy which it is proposed to pursue in the future distribution of the forests.

In the first place it has been decided to allot to purchase contractors some of the forests which have hitherto been worked by the Forest Department. With this object departmental extraction will be gradually decreased and more forests thrown open to private enterprise, but it is not proposed suddenly to abandon all departmental extraction, and the working of the teak forests in the Tharrawaddy, Zigôn and part of the Prome Division will, for the present, remain in the hands of the Forest Department.

As new forest blocks become available for allotment these will be notified by public advertisement, and tenders for working them, under conditions approved by the Lieutenant-Governor, will be called for.

Secondly, with reference to such forests as are already held under leases by the various firms working timber in Burma, in the re-allotment of these, preference will, if possible, be given to the firm holding the existing lease, provided that their work under the existing lease has been satisfactory. The areas allotted under future leases will not, however, be necessarily identical with those held under existing leases from which it may be desirable to

exclude portions for allotment to other firms, or for exploitation by local traders. In cases where the character of the work in any block is likely to be materially changed, the block may be publicly notified and tenders called for.

The general policy to be adopted in the allotment of the forests will be to distribute them with proper regard to the existing arrangements for working them and with the aim of encouraging competition but not to the detriment of firms already working. In the case of the new forests which will be thrown open from time to time applications from firms already working will be duly considered.

Tenders will be invited for the new forest blocks, and the rates of royalty will be fixed by tender, but Government will not bind itself to accept the highest tender as other considerations such as the desirability of a fair distribution of these areas must be taken into account. In the case of the forests already leased if their work under the current lease has been satisfactory, the firms holding the leases will be informed of the conditions under which new leases will be granted, and will be invited in each case to make an application for a new lease of the forest they now have, stating the rates of royalty they are willing to pay.

His Honour has also decided that it will be preferable to give leases for longer terms than have hitherto been granted, and will be prepared, should the timber firms desire it, to enter into agreements with them for 10 or 15 years with a promise of renewal for a like period, subject to a revision of rates if the work under the lease has been satisfactory.

The Pyinmana forests have of late years been worked under special conditions, and short term contracts have been granted for the extraction of a certain number of trees. It has been represented that this is inconvenient as the timber firms holding these contracts have no assurance of further employment when these come to an end. The Lieutenant-Governor has therefore decided to divide the Pyinmana forests into four blocks, namely: (*i*) The forests drained by the Sinthe and Ngalaik *chaungs*; (*ii*) the Minbyin reserve; (*iii*) the Yonbin, Palwe and Yeni reserves;

and (*iv*) the forest east of the Railway line. The approximate number of trees to be girdled in these blocks can be ascertained from the Conservator of Forests, Southern Circle, and tenders for long leases of these areas will be entertained. In respect of blocks (*i*), (*ii*) and (*iii*), preference will be given to the firms already working in these blocks.

In future leases Government cannot undertake to girdle a fixed number of trees, but where working plans are in force the numbers prescribed by these plans, which will be announced, may be taken to be fairly accurate, and will be worked up to as closely as possible. Forests for which regular working plans do not exist will be girdled over in accordance with pre-arranged girdling schemes, that is to say, the areas to be girdled over will be fixed and will be systematically girdled over, but the number of trees to be girdled will not be fixed nor estimated with any accuracy The trees will, however, be girdled three years before felling is permitted, and traders will thus have full time to arrange for their extraction.

The Lieutenant-Governor will proceed to allot the forests on the above principles, and negotiations for the renewal of existing leases may be commenced forthwith. *In case satisfactory arrangements cannot be concluded with a firm holding an existing lease, tenders will be invited by public notice.*

A list of forests to be disposed of under these orders is attached to the Resolution.—*Indian Trade Journal.*

THE COLONIAL EXHIBITION HELD AT MARSEILLES IN 1906.

(EXTRACT FROM THE REPORT BY MR. S. G. ROBERTS., I.C.S.)

FOREST PRODUCE.

* * * * *

16. The produce of the Algerian forest is displayed in a handsome little pavilion built chiefly of ordinary blue-gum wood close to the Algerian palace. I went to the exhibition chiefly to get new ideas and observed the principles on which our friends are working. For this reason I regard the opening sentence of the separate guide to the forestry pavilion of great importance.

"Protectress of the hillsides and the springs, the regulator of the climate as well as the distribution of water, the forest, under this double duty, fulfils a real mission of public health."

Taking the hectare at 2½ acres instead of its exact equivalent of 2·471 acres, we find that the total extent of the forests under the control of the Algerian Forest Service (1,877,000 hectares of State forests and 70,000 hectares of communal or sectional forests) amounts to a little over 7,600 square miles. In charge of this there are 60 French officers of the Cadre Metropolitain or Imperial Forest Service, who are appointed from France. They are Conservators, Inspectors, Assistant Inspectors and Guards-General and are all appointed from France and distributed among the three conservation districts of Algiers, Aran and Constantine. There are in addition a number of Inspectors charged with special comptrollers' duties.

17. The Provincial Service of "Officers in charge" is appointed by the Governor-General. It is recruited in Algeria under the same rules as govern the recruiting of the Imperial Branch, and consists of 145 French "Brigadiers," 625 French Forest Guards and 201 Native Forest Guards. The Brigadiers correspond to D. F. O's., the Guards to Rangers. Thus there are (not counting the Comptrollers) a staff of French Supervising Officers of one man to every 127 square miles of actual forest and of French Forest Officers of rather more than 1 to every 10 square miles of forest. If one adds in the staff of native Rangers (who are just as fully trained as the others), the total of District Forest Officers and Rangers is more than 1 to every 8 square miles of actual forest. The three forest "conservations" are divided up into "Chefferies," or Forest Head-quarters Circles, nine in Algiers, seven in Aran and fourteen in Constantine. Of course, the size of the charges held varies according to the nature of the forest produce, being smallest in the cork-oak forests, where the production of cork is carried on under regular excise supervision, but the advantages of a sufficiently strong forest service are shown even on the financial side by the increase in the income from forests between 1890 and 1905. In 1890 it was only 300,000 francs, or Rs. 1,80,000

and in 1905 it was 441,584¼ francs or Rs. 26,49,480. Of this 3,525,769 francs or Rs. 21,15,459 came from the cork forest, but on the other hand there are payments in kind of one sort and another, apart from the cash receipts, and these payments amounted to the value of more than 2,000,000 francs (twelve lakhs of rupees) in 1890 and came to about 6,500,000 (thirty-nine lakhs) in 1905. The following are the chief duties of the " Streams and Forest " Service : (1) the working of the forest by regular rotation of coupes, by the annual harvest of cork (under direct excise supervision) and by the delivery, under control, of all other produce ; (2) the protection of the numerous native population bordering on the reserves by assuring them such rights of use of the wood and such rights of way as have been recognised ; (3) the forbidding and repressing of all damage to state forests and the supervision of private woods. " The working of these and, above all, the clearing of such woods for cultivation, are pretty closely regulated, because of their reaction on the general economy of the country, its well being and its healthiness." One of the points which I came prepared to enquire into was, the recent discovery of the way to utilize a kind of oak, chêne zeen (*Quercus Mirbeckii*). It is an interesting example of what can be done by study of forest produce. The mean annual export of Algerian wine is about four and a half million hectolitres. A hectolitre being 22·01 gallons, the total export is equivalent of about ninety-nine million gallons, and it is still growing. There is, therefore, a great demand for oak for cask-making and this has to be imported from Russia and even from America. Till quite recently the wood of the *Quercus Mirbeckii* was supposed to be only good for Railway sleepers, as it split and warped. It has now been discovered that it is possible to make staves for casks out of this wood and to dry them in the shade for some years. This makes excellent casks which are rather heavy but at the same time stand a great deal of knocking about. Such a discovery is of first rate economic importance and is certain to lead to a large increase in the forest revenue as there will be 100,000 cubic metres available annually or more than 130,000 cubic yards.

TO IMPROVE SANDY SOILS.

It is a well-known fact that leguminous plants have the power, through the action of bacteria in the soil, of taking nitrogen directly from the atmosphere and transforming this into a condition in which it is available in the soil as a valuable plant food, thus greatly enriching the soil. As many of these leguminous plants will thrive in very poor soils, which will not support other crops, they are often grown as manurial crops and enrich the soil in plant food so that other crops may follow them. Clovers, various peas and beans, *Crotalaria* and the sensitive plant (*Mimosa*) are thus used in different countries. A remarkable instance of the enriching power of these leguminous plants is recorded in the case of a yellow-flowered clover, *Melilotus officinalis*. Many years ago a Dutch vessel was wrecked on the coast of King Island, lying to the south of Australia towards Tasmania. Some of the sailors' mattresses, which were stuffed with "Melilot grass," were washed ashore. The dried plants thus used in the mattresses contained some seeds, and these germinated and grew on the beach, and gradually the plants spread. The result has been wonderful. We quote Mr. H. C. MacDougall on the subject :—

"The fertilising power of this plant has transformed King Island from an island of useless sand dunes into one of the best

grazing districts of the Commonwealth. This wonderful grass, sown on raw white beach sand, has, in the course of five years, changed the character of it, until, at the end of that time, it has become a dark brown colour, in some places almost black Every year it is improving the value of the land."—*Tropical Agriculturist.*

EFFECT OF MOISTURE ON WOOD.

OFFICIAL INVESTIGATION IN AMERICA.

In his Report on the trade of Philadelphia for 1906 Mr. Consul Powell states that the United States Government forest service has, during the last three years, been making a thorough study of the influence of moisture on the strength of wood, and that the chief points presented by the study are:—

1. The relation of moisture to strength follows a definite law which can be graphically expressed. Proper drying very greatly increases the strength of all kinds of wood, the amount of increase in strength depending upon the species and the dryness. The increased strength given to green wood by thoroughly drying it is so great that it will surprise many. For example, the strength of a piece of unseasoned red spruce may be increased over 400 per cent by a thorough drying at the temperature of boiling water. Strength decreases again, however, as the wood reabsorbs moisture. Air-dried wood protected from the weather and containing 12 per cent of moisture is from 1·7 to 2·4 times stronger than when green, varying with the species. Stiffness is also increased by drying. These conclusions, however, are drawn from small-sized pieces not exceeding 4 by 4 inches in cross section such as are used in the manufacture of vehicles, tools, etc. Large timber requires years of drying before the moisture is reduced to the point where strength begins to increase. It must also be taken into consideration that more or less checking always occurs when large timber dries; and if this checking is excessive it may cause weakness to counterbalance, partially or entirely, the strength gained in drying. Consequently it is not safe to assume that the

average strength of large, so-called seasoned timber is much greater than that of green or wet ones.

2. The *fibre saturation point* of a number of species has been determined. This point, which varies with conditions and species of wood, designates the percentage of water which will saturate the fibres of the wood. It has been found that under normal conditions wood fibre will absorb a definite amount of moisture, beyond which the water simply fills the pores of the wood like honey in honeycomb. Only that water which permeates the wood fibre has an influence upon the strength. For the following species the saturation point occurs at the given percentage of moisture based on the dry weight of the wood :—

	Percentage of moisture.
Longleaf pine	25
Red spruce	31
Chestnut	25
Loblolly pine sapwood	24
Red gum	25
,, fir	23
White ash	20·5
Norway pine	30
Western tamarack	30

3. Prolonged *soaking* in cold water does not reduce the strength of green wood below that of its fibre saturation point, provided it remains in perfect condition. When wood has been dried and is resoaked it becomes slightly weaker than when green.

4. Wood *soaked in heated water* absorbs moisture because the amount of water which the fibre will contain is increased. This causes a reduction in strength and stiffness, as in wood that is heated or steamed for bending.—*Indian Trade Journal.*

Photo.-Mechl. Dept., Thomason College, Roorkee. Photo. by F. Beadon Bryant.

Kyathung Bamboo in Compartment 24, Mokka Reserve; successfully protected from fire since 1879.

SCIENTIFIC PAPERS.

FIRE CONSERVANCY IN BURMA.*

(*With four Plates.*)

For some years past Forest Officers in Burma have expressed doubts as to the advantage of fire-protection in teak forests, and many articles have appeared in the *Indian Forester* on the subject.

* *For subsequent official correspondence on this subject see pages 565 to 568* under Extracts from official correspondence.

The note of alarm was first sounded by the late Mr. Slade, then Deputy Conservator of Forests, who, writing in 1896 in his article entitled "Too much Fire-protection in Burma," * drew attention to the subject. Since then quite a mass of literature on the subject has accumulated, but we are still searching for a solution to this all-important question. A perusal of the remarks made in the Forest Administration Reports of late years on the subject of natural reproduction in teak forests will show, however, that the apprehension that we are not treating the teak forests correctly is growing stronger, and that such facts as have so far been collected go to show that a continuance of the present policy of fire-protection combined with the selection method of treatment will lead to the extermination of natural grown teak over very large areas of our most valuable teak producing forests.

It will be remembered that the subject was exhaustively discussed in 1897, when it was decided that fire-protection should be extended as far as funds and administrative considerations allowed. Since this decision was arrived at, fire conservancy has been extended to an area of 8,213 square miles as against 1,856 square miles in 1896-97 and the expenditure on these operations during 1905-06 amounted to Rs. 2,91,412. To justify such an expenditure it should be clearly shown that substantial benefits are being realised.

It has been stated that as the success of fire conservancy in Burma is not yet assured, discussions as to its effects on forest growth are somewhat academic. There are, however, in parts of Burma, teak forests which have been successfully protected for 20 years and more, notably in the Tharrawaddy Division in Lower Burma. These forests are some of the most valuable in the Province, and have for the past 10 years been bringing in an average annual revenue of some 15 lakhs of rupees, nearly all of which, it may be remarked incidentally, has been realised from teak trees which have grown to maturity in forests annually burnt over. Observations as to the effect of prolonged fire-protection can therefore be safely made in these forests, which are typical Lower Burma teak producing areas.

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* See *Indian Forester* for May 1896, pages 173 to 176.

Mr. Troup, Deputy Conservator of Forests, when in charge of the Tharrawaddy Division in 1905, made some valuable observations as to the difference in growth between the teak in areas long protected from fire and in areas annually burnt; the data he collected are recorded in the *Indian Forester* for March 1905, pages 138 to 146, to which a reference is invited. Mr. Troup enumerated the stock in two plots, A and B, adjoining each other and similar in character, of which the former had been successfully protected for 19 years, the latter being annually burnt over. Reducing the number of trees counted to the number which would be found on 50 acres, the following results were obtained :—

	Plot A. Protected for 19 years.	Plot B. Annually burnt over.
I. Poles of 1 foot to 2 feet in girth—		
(a) Sound	174	135
(b) Unsound and dead	109	29
II. Poles and saplings under 1 foot in girth—		
(a) Sound	24	141
(b) Unsound and dead	121	37
III. Seedlings	62	616

Mr. Troup found that nearly half of the sound poles in plot A were still in danger of suppression whilst in plot B the poles were mostly strong and vigorous, showing no signs of damage from fire, and that owing to the annual fires keeping down the bamboos these poles were in little danger of suppression. It appears certain that in a few more years most of the poles in plot A will disappear, and it is evident that there is no chance that the forest here can ever, under the present conditions, become properly stocked. On the contrary the teak must eventually disappear.

During the past cold weather I visited the Tharrawaddy forests expressly in order to obtain further information as to the effects of fire conservancy and arranged to have further countings made over sample areas. I had the advantage of meeting Mr.

Troup and Mr. Caccia from the Imperial Forest College, Dehra Dun, and of discussing the question with them and with Mr. S. Carr, the Divisional Forest Officer. At the suggestion of Mr. Caccia, some of the old sample areas enumerated when the working-plans were prepared (1885) were counted out. Unfortunately owing to the old maps not being forthcoming at the time of my

				Unsound green teak trees		Sound green		
Number of sample plot.	Working Circle.	Number of compartment.	Area in acres.	Above 1 foot diameter.	Below 1 foot diameter.	Above $2\frac{1}{2}$ feet diameter.	2 to $2\frac{1}{2}$ feet diameter.	$1\frac{1}{2}$ to 2 feet diameter.
1	2	3	4	5	6	7	8	9
1	Kon Bilin ...	11	66	5	3	26	8	113
				8	*5*	*39*	*12*	*171*
				17	...	39	24	69
				26	...	*59*	*36*	*105*
2	Kon Bilin ...	8	106	28	54	26	58	268
				26	*51*	*24*	*55*	*253*
				21	11	49	64	115
				20	*10*	*46*	*60*	*108*
3	Kon Bilin ...	19 & 20	60	3	6	8	11	56
				5	*10*	*13*	*18*	*93*
				6	4	18	12	26
				10	*7*	*30*	*20*	*43*
6	Kadin Bilin ...	19	43	18	9	3	6	55
				42	*21*	*7*	*14*	*128*
				19	...	5	22	55
				44	...	*10*	*51*	*128*

visit, it was only found possible to re-enumerate the stock now standing in the plots originally enumerated in four cases. An area of 275 acres was, however, counted out in various parts of the Kon Bilin and Kadin Bilin reserves and the stock now existing can be compared with that on the same ground 22 years ago. The following results were obtained :—

TEAK TREES.				Number of years successfully protected from fire.	REMARKS
1 foot to 1½ feet diameter.	6 inches to 1 foot diameter.	Under 6 inches diameter. Dominant.	Under 6 inches diameter. Suppressed.		
10	11	12	13	14	15
67	98	49	191	14	...... Countings made in 1906.
103	*148*	*74*	*289*	...	=per 100 acres
265	728		246	...	...... Countings made in 1885.
402	*1,103*		*373*	...	=per 100 acres
431	497	127	187	*19*	...... Countings made in 1906.
407	*469*	*120*	*176*	...	=per 100 acres
515	1,357		602	...	...... Countings made in 1885.
486	*1,280*		*568*	...	=per 100 acres
41	56	103	478	3	...... Countings made in 1906.
68	*93*	*172*	*797*	...	=per 100 acres
50	210		169	...	...... Countings made in 1885.
83	*350*		*282*	...	=per 100 acres
49	127	103	133	...	...... Countings made in 1906.
114	*295*	*240*	*309*	...	=per 100 acres
79	208		198	...	...... Countings made in 1885.
184	*484*		*460*	...	=per 100 acres

The countings were carried out under the immediate supervision of one or more of the European officers present and are believed to be accurate. All seedlings that could be found were counted. But it is probable that many were overlooked in the present and in the former countings. The countings of seedlings give, however, a good idea of the present state of affairs and the figures for saplings and trees of more than 6 inches in diameter may be accepted as fairly accurate.

We find that in Plot No. 1, protected from fire for 14 years, there are now only 338 stems of 1 foot and under in diameter against 974 recorded in 1885. Similarly there are now only 67 trees of from 1 foot to 1½ feet in diameter against 265 in 1885. The trees between 1½ feet to 2 feet have increased from 69 to 113. The differences in the trees of 2 feet and over in diameter tell us nothing as girdling was undertaken in 1898-99 and we do not know how many trees were girdled in the sample plot.

In Plot 2, known not to have been burnt for 19 years and probably not for 28 years, we find the some state of affairs: 811 trees of 1 foot in diameter and under against 1,959 in 1885, and 431 trees of from 1 foot to 1½ feet in diameter against 515.

In Plot No. 3 fire-protection has been successful for three years only. The youngest class is much better represented than it was in 1885; here also there is a falling off in the poles of 1 foot to 1½ feet in diameter, but not nearly so large as in Plots 1 and 2, and about the same increased number of trees of from 1½ feet to 2 feet is apparent as in Plot 1.

In Plot 6 there has been no fire-protection and here also there is a falling off in the trees of 1½ feet in diameter and under, but again the decrease is not nearly so much marked as in Plot 1, for instance, and the two youngest classes are much the same as they were 22 years ago.

In the remaining six plots, the old countings are not available for comparison. It is however interesting to compare the figures now obtained, as shown on the next page, with the original working-plan estimates, both being reduced to 100 acre units.

Plot No.	Number of years fire-protected.	Number of trees below 1 foot in diameter per 100 acres in 1906.	Number of trees below 1 foot in diameter per 100 acres according to working-plan estimates in 1885.	*Plus* (+)	*Minus.* (—)
1	2	3	4	5	6
4	14	802	955	...	153
5	3	576	947	...	371
7*	19	481	724	...	243
8	...	962	457	505	...
9	4	1,482	1,505	...	23
10†	19	930	914	16	...

All that is apparent from these plots is that in the plots longest protected from fire, *i.e.*, Plot 4 (14 years), Plot 7 (19 years), Plot 10 (19 years), the younger classes are badly represented.

I would invite particular attention to the countings of the youngest classes in Plot 7 where after successful fire-protection has been in force for 19 years for certain, and probably for 28 years, and where, as in all the plots, there are plenty of seed bearers, there are now on the ground only 59 teak plants of 6 inches diameter and under on an area of 38 acres. Most of these are still in danger of suppression, and it is merely a question of a further longer or shorter period of successful fire-protection for the natural grown teak to entirely disappear from these forests. So far therefore from it being proved that we are deriving substantial benefits from the large expenditure incurred annually, it seems that most serious harm is being done.

* This plot shows a considerable increase in the number of trees of 1 foot to 2 feet diameter. It is believed that an area of plantation was included in the area counted.

† This plot also shows a considerable increase in the number of poles, but owing to the working-plan estimate having been based on a sample plot of only 26 acres and to numerous sowing and planting operations having been carried out here, these countings are not of much value.

So far as the Tharrawaddy forests are concerned, it may, in my opinion, be taken as proved that prolonged fire-protection results in a marked decrease of trees of the younger classes. Those on the ground before fire-protection came into force pass up into the upper classes, but those which spring up afterwards for the most part either damp off or are suppressed by the heavy cover of the *kyathaung* (*Bambusa polymorpha*) and *tin* (*Cephalostachyum pergracile*) bamboos which benefit enormously from fire-protection, and which are driving out practically everything before them. These giants grow to 90 to 100 feet in height in a single rainy season and are killing out not only the teak but all other species except those that can support the heaviest of cover. Plate 21 shows *kyathaungwa* forest in which teak cannot persist and which we are assiduously aiding and encouraging by the present system of management. This type of forest now holds the ground over many hundreds, if not thousands, of square miles in Burma. It has been held that when this *kyathaungwa* seeds and dies, as it is expected to do in the near future, then will be our great opportunity for inducing teak regeneration. But with long continued fire conservancy, new factors have arisen in the growth of young *kyathaungwa* which may often be found springing up under the old clumps, and of young *tinwa* bamboo which also establishes itself under the *kyathaungwa*. It flourishes exceedingly with fire-protection and is there ready to take the place of the *kyathaung* should this seed and die. (Plates 22 and 23.)

Teak is a light-demander and cannot persist under the heavy cover which grows denser year by year in forests protected from fire, and this is the sole reason why fire-protection combined with the selection method is in moist forests resulting everywhere in Burma in a marked decrease in the younger classes and a marked absence of healthy young growth ready to grow up into the forests of the future. My many tours of inspection during the last three years have convinced me that what is taking place in Tharrawaddy is taking place in all moist forests under fire-protection in Burma, *i.e.*, the teak is being gradually and surely killed out. In forests annually burnt over, on the other hand, the cover remains

Photo.-Mechl. Dept., Thomason College, Roorkee

Photo. by F. Beadon Bryant.

Young Tin Bamboo under Kyathaung in Compartment 79,
Kadin Bilin Reserve; successfully protected from fire since 1893.

Photo.-Mechl. Dept., Thomason College, Roorkee. Photo. by F. Beadon Bryant.

Tin and Kyathung Bamboo mixed in Compartment 21, Mokka Reserve; successfully protected from fire since 1879. Old stump Teak, no young Teak.

considerably lighter than where protection is in force and the young teak resisting the effects of fire better than its companions is able to and does establish itself. (See Plate 24.)

The damage done by fire is admitted on all sides, though it is much less in the moist teak forests than in the dry, where, as Mr. Rodger has shown us by his article,* an enormous amount of damage is done by fire.

Another strong point in favour of fire conservancy is the great improvement of the soil which takes place in fire-protected forests. In the Tharrawaddy forests first protected, there is now a perfect forest soil, soft under foot, and although true humus formed from decaying leaves may not be present, the soil must retain the same nutritive properties as would true humus. To quote Mr. Ribbentrop writing of this question: "There can be no doubt that in fire-protected forests the leaves and other decaying vegetable substances are returned to the earth and that the chemical properties of humus are imported to the surface soil which is moreover loosened by the action of myriads of earth worms, ants, beetles, etc." In the case of forests burnt over the wind dissipates the ashes and the rain washes them away especially on hilly ground. Very little of what is extracted from the ground is returned to it. Against these undoubted benefits arising from fire-protection, must be placed the fact that in certain classes of forests fire-protection is killing out the teak altogether.

When the question as to whether fire-protection should be continued or not was discussed in 1897, Mr. Ribbentrop, then Inspector-General of Forests, discussed the question in his letter No. 356, dated the 26th April 1897, to the Burma Government. He concluded that fire-protection ought to be continued and extended as far as funds and administrative considerations allowed. His main reasons were :—

(1) That fire-protection improved the soil.

(2) That the number of teak seedlings in a fire-protected forest are healtheir, grow faster and will yield better timber than those grown in areas annually burnt.

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* See *Indian Forester* for August 1904, pages 372 to 374.

(3) That the damage done to young tree-growth by fire cannot be prevented by any other means than fire-protection, while impediments to reproduction and future growth which may be due to fire-protection can be prevented by other means.

As to (1) this is fully admitted. As to (2) and (3), the countings made by Mr. Troup and by me quoted above prove conclusively that long continued fire-protection in moist forests has resulted in a very large decrease in the two youngest classes, and that, if continued, there is good reason to anticipate that natural grown teak will cease to exist. This state of affairs has come about notwithstanding the continued efforts of the Forest Officers in charge, aided by the students of the Forest School who have never ceased to wage war against the increasing density of the cover by improvement fellings, and to endeavour to increase the proportion of teak in the crop by sowings and dibblings. But the hand of man can in this manner influence to but a very small degree the forces of nature. It would be equally easy to stop the tide as to keep down the growth of inferior species and bamboo, which, fostered by fire-protection, is impossible to control. The fact is that Forest Officers of former days were unable to correctly appreciate the results of fire conservancy on the teak forests, for it had not then been long enough in force. Thus Mr. Corbett, as a result of enquiries instituted as to the relative number of teak up to 20 feet in height in protected and unprotected areas, reported in 1898 that the number of teak plants from 6 feet to 20 feet high was three times as many in the fire-protected area as outside it. His observations were taken in a forest which had been under protection for five years only, and are consequently valueless.

The fact which has been frequently observed that insects are more numerous in fire-protected areas than outside must not be lost sight of. It is by no means proved, however, that they do more harm in forests protected from fire than elsewhere. Indeed most of the teak which in certain districts loses so much of its value owing to the attack of the beehole borer has hitherto come from areas overrun by fire.

Photo.-Mechl. Dept. Thomason College, Roorkee. Photo. by F. Beadon Bryant.

Young Teak with Kyathaung Bamboo in Compartment 58,
Kadin Reserve; never been fire protected.

There can be no doubt that much of the unsound teak to be found in all our forests is due to the action of fires, which cut back the young trees year by year until they send up a shoot strong enough to resist fire. The damage thus sustained in its earliest years undoubtedly causes many a tree to become unsound, and as the unsoundness develops the annual fires do more and more damage to the tree.

This appears to me to exhaust the arguments for and against fire conservancy, and it remains to discuss what action can be taken. It is necessary to distinguish broad classes of forests inasmuch as the evil effects of fire-protection are much less in some forests than in others, and indeed over large areas the effect of keeping out fires is, as far as can be seen at present, highly beneficial. In classifying the teak forests in Burma, I cannot do better than follow the Inspector-General of Forests who in his letter above quoted recognised the following three classes :—

(A) Forests in which the valuable species are found with an undergrowth of evergreen dense, periodically and gregariously flowering bamboos, which more or less prevent the natural reproduction of tree growth at any other time except whilst the bamboo is seeding. To this I would add "or forests which are of a moist evergreen nature, where, with the aid of fire-protection, evergreen is encroaching on the teak."

(B) Forests in which the undergrowth consists of bamboos with a lighter foliage and which flower sporadically in stems or clumps as well as gregariously, and in which tree reproduction can always take place, but more especially when the cover has been opened out by the general, but also by the sporadic, flowering of the bamboo.

(C) Forests in which the more valuable trees are found in a mixed or pure forest (which latter is, apart from small areas, almost entirely confined to cutch), and with an undergrowth of shrubs and herbaceous plants and grasses only.

It is in forests of Class A, to which most of the Tharrawaddy forests may be said to belong, that fire-protection is doing the most harm, for whatever benefit may be arising from it there is no getting over the fact that, if continued, naturally grown teak will cease to exist in this class of forest.

The only way to realise the undoubted benefits arising from fire-protection and to maintain the teak in these forests is to change the method of treatment. The teak being a light-demanding tree which cannot establish itself under the shade of the bamboos and of the many species with heavy cover with which it is associated, is not adapted to treatment by the selection method combined with fire conservancy. The flourishing *taungya* plantations of even aged teak poles, some of them now some 40 years of age, show us that it is quite possible to grow even aged crops of teak, and though it not possible at present to say whether this plantation teak will at maturity yield such valuable timber as can be obtained from the natural forests hitherto overrun by fire, there is reason to hope that it will do so. Whilst abandoning fire conservancy in this class of forest, I would therefore endeavour to aim at establishing young growth over a certain proportion of each working circle or forest unit, by concentrating on it plantations, improvement fellings and other measures, such as sowings and dibblings, undertaken in order to induce reproduction. So soon as satisfactory young growth has been obtained over the area thus set aside for regeneration, fire-protection should again be enforced, and when the time comes for revising existing working-plans or framing new ones, the possibility of treating the forests by the regular method should be fully considered.

As regards forests of Class B, it is probable that in many of these fire-protection is beneficial, but it will not be practicable in many cases to protect these whilst allowing fires to run over Class A forests, for the two classes are much intermixed. It will be possible, however, to set aside the forests of this class in which fire-protection is beneficial, and in which it should be continued. In forests of Class C fire-protection is very beneficial and should be continued and extended. Caution must be observed in deciding

over what areas fire conservancy is doing harm, and where it should be abandoned. The forests in each division will be classified broadly into the Classes A, B and C as above defined, and proposals to abandon fire-protection will be submitted for the approval of the Chief Conservator without whose sanction no change should be made.

In considering these proposals, I beg that it may not be forgotten that the forest fires in Burma are of a very mild type compared to those of which Indian Forest Officers have experience. In the forests of Class A, where it is now proposed to abandon fire conservancy, the fires will be generally little more than ground fires, and they will do but little harm to the established teak trees. The present state of affairs should not be allowed to continue. We are spending nearly 3 lakhs of rupees per annum, and, as a result, over very large areas are killing out our most valuable species, which, in conclusion it may be remarked, forms valuable and extensive forests without any aid from fire conservancy.

F. BEADON BRYANT,
Chief Conservator of Forests, Burma.

ORIGINAL ARTICLES.

REPRODUCTION OF SAL FROM SEED IN THE JALPAIGURI DIVISION.

In the article "Reproduction of Sal from Seed" Mr. McIntire recommends cleaning and weeding *until the seedlings* are out of danger, while Mr. Jacob says firing would be cheaper and more effective. I have been in the locality referred to by both Messrs. McIntire and Jacob for the last two years as a Range Officer, and have been doing cleaning and weeding work most carefully, noticing the results very minutely. What I gather from observation is noted below.

For the purpose of reproduction the forest may be divided into two classes, *viz.* :—

Type I—Forest with close cover having no grass underneath ; and

Type II—Forest with open cover having much grass underneath.

In Type I Forest, the trees are standing very closely ; the grass has been killed by shade and the creepers also. In Type II Forest, the trees are very scattered, the grass gets sufficient light to live, but there are practically no creepers.

Type I Forest.

In Type I the cleaning and weeding will not do much good if it is taken in hand just after felling and continued for five years (as is prescribed in the Working-plan of Jalpaiguri Division). The aim of this operation is to help the sal seedlings in the struggle for existence by weeding and cutting back the inferior species and creepers annually for five years. But I am sure the inferior species will get the upper hand directly the operation is stopped.

Sal seedlings naturally die down annually for some period of their life and take at least six or seven years to establish themselves. They will die down yearly whether they are helped by cleaning or not, on the other hand they will grow better if shaded by a nurse for some years. Granting that they do not die down if they are helped by cleaning and weeding, they will grow up to 3 ft. to 4 ft. height only in five years, in the 6th year they will be 5 ft. high at the utmost ; the coppice shoots of inferior species also will grow 6 ft. to 10 ft. by that time, thus from that year the struggle for existence begins, and the sal seedlings will meet with the same fate as those not favoured with cleanings. In this case of course they will live longer by seven or eight years than the unfavoured ones, but the result will be the same except for the waste of money. If the chief aim is to keep down creepers, it is disappointing to notice at the end of the rains how little the creepers have been effected by the operation. The operation begins from November, but in April the creepers are found coming up with new vigour. Creepers may be better kept down by suppression, by keeping them under close

cover. Sal is a shade-bearing species for a few years at the beginning of its life. After a felling innumerable sal seedlings, also lots of creepers will come up. The reason of this sudden appearance of sal is probably that at the felling, the soil, which was so long too *damp* for the production of sal, was exposed and aerated and has thus become suitable for the reception and germination of the seed. If the coppice shoots of the inferior species are not cut back for some years the creepers will disappear gradually for want of light, but sal will live on (being a shade-bearing species during the first stage of its life). If the cleaning operation is undertaken at this stage, and the heads of young saplings opened out they will grow on rapidly and the operation will be most successful.

Regarding fire-protection, in Type I Forest, I venture to say that fire can do no harm at all; on the other hand, it does some good by burning part of the humus which has become too wet and sour, and thus making it drier and more aerated. In these localities the ground always remains too wet for fire to proceed far, except from March to June when it is partly covered with dry leaves. The fire then only burns the fallen leaves and cannot do any damage. The ground remains so wet even in February that the accidental fires from outside burn themselves out even if no measures are taken to put them out. This was found out by actual observation from some fire cases which did not come to the notice of anybody until they had burned themselves out.

Type II Forest.

In Type II Forest after a felling, in which generally very few trees are removed, the grass tries its best to occupy the blanks made by the felling, and hardly any creepers appear. Here in the cleaning and weeding, the heads of the sal seedlings are freed by removing the grass and the inferior species. Being protected from fire the grass grows on every year without any obstruction, it dies down in winter, and during the rains it gets bent down, congested and too thick to allow the sunlight to reach the soil. Thus the condition of the soil is practically the same as in Type I Forest. Here cleaning and weeding would be more beneficial than in the other type. *Firing would be not only cheaper but more effective.* The grass

being too thick and congested, few seeds can reach the soil and those that can reach it, either cannot germinate or if they do germinate, the seedlings resulting cannot live long in the wet soil. The best way to help reproduction is to fire the area for some years. The thick bark of sal makes it proof against fire. Fires will retard the growth of the trees, but in grassy lands with scattered sal, the chief aim is to fill up the gaps, and the rate of growth of the old trees is not of so much importance. The fire will do more damage to some of the inferior species which are not clothed with thick bark like sal. The firing should to be done annually for some years and then it should be protected. This will enable the sal to reproduce itself profusely. After a fire all the seeds will reach the soil, germinate at once and grow on with the new grass during the rainy season. The seedlings will now get sufficient light through the grass. During the next winter the grass will die down, but the sal seedling will grow on till the spring ; after spring they will put out new shoots and the old ones will cease to grow and die off later on. If the area is burnt again just before the coming up of the new shoots the old grass will be burnt off while the new sal shoots will come up with double vigour after the fire, as is noticed on all the fire-lines in sal forests. New seeds will fall and germinate, and thus the number of sal seedlings will increase gradually. This process should be continued until sufficient sal seedlings have thoroughly established themselves. By this time they will be big enough to win in the struggle for existence with the grass. The soil will get sufficient light for some years before it becomes too wet again ; in the meantime sal saplings will have established themselves and have little to fear from a damp surface soil.

B. SEN GUPTA,
Forest Ranger,
Jalpaiguri Division.

16th November 1907.

THE SPLIT INFINITIVE.

The *Indian Forester* used to describe itself as a "Magazine of Forestry, Shikar and Agriculture." I remember a correspondent, who appealed for more shikar, calling attention to this fact and

quaintly remarking that he did not yearn for "a surfeit of agriculture." As the *Indian Forester* no longer specifies its scope, perhaps a little grammar will not be objected to, provided we do not have a "surfeit of it." These reflections on the split infinitive are suggested by a perusal of the *Forester*, though the subject may be strange to its pages.

Two questions suggest themselves :—

(1) Why is the split infinitive bad grammar?

(2) Is there anything in the life or work of a Forest Officer to make him peculiarly liable to err in this respect.

That the split infinitive is bad grammar there seems to be no doubt. The literary critic is always down on it and the good writers do not use it—why?

The adverb qualifies the verb, and when the emphasis is on the adverb its natural place is before the verb. No one objects to the sentence "I have constantly told you," but one must not write "I have to constantly tell you."

I once asked a man known to me as a stickler for pure English what his objection was and he asked me what my objection was to a squeaking slate pencil. He said that he not only had no temptation to write split infinitives but had no temptation to speak them. Nevertheless the majority of men have a strong tendency to use them and most writers, otherwise well educated, continue to use them until they are laughed at, when they take to going through their manuscripts carefully and removing the "splits." This can be seen in almost any writing of the day from the frequency with which the adverb is placed before the infinitive in sentences where it should come after, with the result that the meaning is ambiguous. Thus the budding Macaulay may write "I told you to constantly practice your art" going through his MS. he says "Oh Law! here's another"—out comes the "constantly" and in it goes again in front of the "to"—"I told you constantly to practice your art"—it is now doubtful which verb the adverb is meant to qualify. After a time he too gets to the "squeaky pencil" state of mind, but the number of writers, who have not been laughed at, is legion. One meets them everywhere—in novels—in magazines—in newspapers—*the leading*

articles in the *Pioneer* are not free. I cull a real beauty from the issue of 17th November "to as far as possible exonerate"! It is clear that this mistake, so irritating to the initiated, is not like other mistakes of grammar. It is not due to want of education—I mean general literary education—it can only be eradicated by special education on the particular point. It seems to be due to the natural desire to make the adverb as *prominent* as possible in some sentences. Why then is it a mistake at all—can anyone give a reason?

Our second question is suggested by the peculiar frequency of "splits" in the *Indian Forester*. I take the following from a recent number:—"to approximately estimate," "to constantly cut back."

The Editorial page has not been free. On one occasion I found to my vexation that the Editor had been kind enough to manufacture one for me—perhaps I ought to say the printer. However I remonstrated with the Editor and was told that I knew nothing about proof correcting. I don't know how he knew of my ignorance. A recent text-book for the Dehra Dun students revels in "splits."

I have not answered question (1), but I will endeavour to answer number (2). We foresters are in such deadly earnest that our adverbs constantly call for the greatest emphasis and we work so hard that we have no time to go back and haul them out from the midst of the infinitives.

SOHELWA.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

THE INDIAN RED DOG.

For many years the gradual diminution of Indian game has been the subject of remark and correspondence in the Indian press both sporting and otherwise. And although in certain districts organized steps have been taken to stem the tide of destruction by closing particular forests for a term of years, by employing shikaris to destroy wild dogs and by limiting the number of animals sportsmen may shoot, over the greater portion of the Indian forests, the subject has not received the attention it deserves and in consequence big game generally and the *Cervidae* in particular show signs of rapid diminution. There is little doubt that of the two main causes of destruction, *viz.*, native shikaris and wild dogs, the latter are the most formidable. Forest reservation appears to have caused the numbers of wild dogs to increase by leaps and bounds. It may be perhaps that the diminished area of forests has brought them into greater prominence. The fact remains, however, that they are much more frequently met with than formerly. Confidence begotten of increasing numbers has introduced an ever-increasing impudent boldness into their original shy and retiring nature.

In certain localities native shikaris are allowed to enter forests for the purpose of killing these pests and when successful are given a substantial reward. This appears to be the only really workable plan and it might with advantage be much more extensively employed. It will be argued that the native would at once take advantage of the concession to poach game. That might be, but the greater advantage of producing dog skins would outweigh the lesser evil of killing a few chital. In order to get at the root of the evil natives employed for this purpose should have impressed upon them the necessity of searching for earths and caves, where dogs are known to breed and of destroying the pups.

I once beat a block of forest into which a party of us had chased a pack of wild dogs, but only when they had been driven out did I discover a number of caves in the side of a small hill for which they had evidently been making when disturbed. Judging from the worn appearance of the ground, the countless tracks, and scraps of skin and bones lying scattered all over the place, these caves must have been the regular haunt of a considerable pack. These caves lie in a block of forest in the Lohara zemindari, Raipur district, close to and on the south side of the track leading from the village of Bhimpara to Rengadubri. Should any sportsman, who happens to read this, pass that way, a visit to this earth would be well worth his while, for should the dogs happen to be at home, there would be nothing to prevent him smoking them out and shooting several.

As a rule wild dogs hunt by sight and I have only once heard of a case in which they were following the scent. A friend of mine was walking along a forest road when a doe sambhar hustled across some little way in front of him. A few moments later a pack of dogs streamed across the road hot on the scent emitting short gasps as they picked it up.

A personal experience gave me some little time ago an unpleasant proof of their increasing boldness. On a certain hot weather evening a friend and myself took our guns and set off for a stroll along the edge of a large track of sal forest in the hope of getting a shot at a chital stag. Our way lay along a path

which ran down the centre of a plain bounded on the one side by the forest and on the other by a stream which eventually broadened out into a huge lagoon. We had not gone very far from camp when we saw a pack of some ten wild dogs, drinking in the stream. They saw us almost at once, but appeared to be in no hurry to move. By walking rapidly straight towards them we got within a hundred yards before the last of the pack had left the water, we now noticed that some half a dozen puppies were with the pack. With his second shot my friend knocked over what turned out to be the mother. The pups at once gathered round the corpse while the remainder of the pack broke into a trot, though evidently loath to leave the puppies. Elated with the idea of getting hold of a pup, a species of pet I had long wished to own, I put down my rifle and ran up to them. They let me get quite close, but do what I could I was quite unable to catch one, they darted here and there like minnows and were just big and active enough to avoid my grasp. All this time the pups were gradually making their way back to the forest, but so intent was I on the chase that I did not notice this. Suddenly the big dogs charged out of the forest straight for me. I turned and ran as hard as I could in the direction of my friend who fired a couple of shots past me at the dogs. They were growling in a most menacing manner and would most certainly have attacked me, but hearing the shots and seeing the pups safe they stopped and I got away, very blown and thoroughly scared. I have never heard of wild dogs attacking a man, but in this case they certainly had no intention of allowing me to catch a pup.

When roaming through jungles, the absolute terror caused by a pack of wild dogs has often been forcibly brought home to me. On one such occasion I remember visiting a small outlying strip of forest, famous for the number of chital it contained. We arrived on the scene very early one morning, and the jungle seemed alive with chital. I shot a good stag and having seen several other good heads went back to camp with the intention of returning next day for another. Early next morning dawn found me on the ground, but to our astonishment there was not a sign of an animal,

not a sound broke the stillness. The whole place wore an air of utter desolation. No sooner had I commenced to move about than I came across the tracks of a pack of dogs. They had ranged, a devastating horde, through the forest and every single living beast had vanished. Some days elapsed before the chital commenced a gradual return to this locality. On another occasion I was roaming through some jungles bordering on the Mahanadi when a friend who was with me spotted a herd of chital and went after them in the hope of finding a decent sized stag. I waited his return on the banks of the river which was practically dry. As soon as my friend fired, the herd dashed off down the bed of the river. A moment later some half a dozen dogs emerged from the forest and took up the chase. I followed their tracks for some distance in the hope of coming up with them if they succeeded in catching one of the chital. After going some way I found that one of the herd had been cut out, and its tracks, followed by those of the dogs, led off in a different direction. I eventually lost them on some hard ground. Under these circumstances it must indeed be the most tragic of jungle deaths. One can picture the final scene. The last despairing effort to shake off the relentness pursuit, the closing in of the pack, the disabling bites in the streaming flanks, one or two hopeless blind rushes and the collapse of the poor beast which is promptly fallen upon by the pack of red brutes whose sharp fangs literally tear it to pieces alive. At times the victim is skilfully herded up to some caves or breeding ground where the growing pups are allowed to try their budding powers on the exhausted victim. Stags when pursued instinctively make for water, where they turn to bay in the vain hope that the depth of water will assist them to ward off the attack. In such cases one permits oneself the hope that drowning mitigates some of the horrors of the final worry. A couple of years ago, I was out with a friend who put in an excellent day's work by shooting no less than three of these brutes—two of them being bitches. Returning to camp after an unsuccessful stalk after bison he met a pack and promptly knocked one over. It crawled into some grass where it was followed and despatched. On coming back to the

path he found the pack had returned in quest of the missing one and he succeeded in shooting two more. These lines have been penned in the hope that any young sportsman who does not realize the absolutely devastating effect red dogs have on the game in a district will resolve to leave no stone unturned to kill off some of these pests whenever an occasion presents itself and thereby earn the gratitude of his fellow shikaris.—"*J. L. F. T.*" *in The Indian Field.*

EXTRACTS FROM OFFICIAL PAPERS.

FIRE CONSERVANCY IN BURMA.

Copy of Letter No. 1875, *dated the 7th September* 1907, *from the Inspector-General of Forests to the Government of India, to the Revenue Secretary to the Government of Burma.*

I have the honour to forward copy of a letter No. 716-5F.-1, dated the 19th August 1907, from the Chief Conservator of Forests, Burma, together with a memorandum entitled "Fire Conservancy in Burma" * and to add the following remarks for the information of His Honour the Lieutenant-Governor. It is understood that the proposed publication of the memorandum has been deferred pending the issue of orders by the Local Government.

2. In the first place it will be recognised that it is but lately that it has been possible to judge of the influences of continuously successful fire conservancy in Burma. The Forest Officers of the past had to deal with areas ravaged by centuries of annually recurring fires and their attention was naturally attracted to the consequent poverty of the soil, to the universal injury to the timber stock, and (as they then thought) to the insufficient reproduction of the most valuable species. They took the obvious course to remedy these evils and with undoubted success in very many instances over large areas, but they could not be expected to know what we have since learnt solely by experience that a period is reached when fire-protection gives to the evergreen species and to bamboo growth that vitality and preponderance which becomes prohibitory of the

* See pages 537 to 549 of this number.

regeneration of light-demanding species. We have in fact arrived at a phase of sylviculture in Burma and elsewhere with which our predecessors had but little concern.

3. It is not only in Burma that this important question is under discussion but everywhere throughout India where the mean annual rainfall and the minimum annual temperature is such as to favour the growth of evergreen vegetation. In the deciduous forests of Central and Northern India where conditions are vastly different the beneficial effects of Fire Conservancy have never been called in question, and, as Mr. Bryant points out, there are large areas in Burma where its effects are undoubtedly favourable The necessity of classifying forests growing under different physical conditions is therefore obvious, and the statement that Fire Conservancy is useful or the reverse can only possess any meaning when it is known to what class of forest it is applied.

4. The main result we expect to derive from Fire Conservancy consists in a more rapid growth of sound timber owing to the enrichment of the soil and the protection from injury of the crop; but it is obvious that we cannot profit by these advantages if the method we employ to obtain them causes the disappearance (through prevention of reproduction owing to mechanical disabilities) of the most valuable species. Had we a smaller area and a larger staff and population to deal with, it is equally obvious that we should contend against these disabilities by using the controllable and discriminating forces of man rather than those of fire and in other parts of India, notably in the submontane forests of Bengal, this is being experimentally carried out with, it is reported, successful results. In other localities again where the evergreen forest has obtained the upper hand it has been found difficult to arrest its progress even by the action of fire.

5. I am ready to acknowledge with the Chief Conservator the impotence of the Forest Department to control, with the means at present at our disposal, the unhampered forces of nature and admit that it is better to provide for a slow growing and inferior crop of teak than to accept in its place a luxuriant forest vegetation for which we have no use, and I would therefore agree generally

to the classification of forests which is proposed. But I would not advise that any final orders be issued by the Local Government at this time dividing the whole of the Burma forests into the classes A, B, C *of the memorandum and laying down specific treatment* for each. Rather would I advocate that the Chief Conservator should in consultation with his Conservators select in each Circle or Division suitable areas of sufficient size where the effects of the abandonment of Fire Conservancy can be carefully watched and from whence, if the results justify it, the system now advocated can be extended from year to year. For we are still working in the dark and it is by no means proved that if the absence of fire is preventive of teak reproduction, its reintroduction will have the opposite effect.

6. I observe in paragraph 16 of the memorandum, that it is proposed to concentrate plantations, etc., on a certain proportion of each forest unit in which re-protection has been abandoned. In this regard I would refer to the correspondence ending with the Department of Revenue and Agriculture letter No. 381-F., dated the 13th March 1907, in which it was decided to greatly restrict the "taungya" operations in Burma. I would point out that if plantation work is to be resumed on any large scale there would be the less necessity for the proposal to induce the natural reproduction of teak dibblings and the other less expensive methods of artificial regeneration be resorted to, where necessary, in preference to plantation work to which the staff will probably have little time to attend in that detail which is desirable.

Copy of letter No. 906 *C*-4-*F*-1, *dated the* 15*th October* 1907, *from the Revenue Secretary to the Government of Burma, to all Conservators of Forests in Burma.*

I am directed to forward a memorandum on "Fire Conservancy in Burma" by the Chief Conservator of Forests, and a copy of a letter No. 1875, dated the 7th September 1907, from the Inspector-General of Forests, giving his advice on the proposals made.

2. I am to say that the Lieutenant-Governor accepts the advice of the Chief Conservator of Forests as modified by the Inspector-General of Forests, and steps should now be taken to abandon Fire

Conservancy over selected areas in each Circle or Division where most harm appears to have been caused. The Chief Conservator of Forests will consult Conservators as to the selection of areas in which fire-protection should be abandoned and will issue the necessary detailed instructions. Protection should not be abandoned over any area without the Chief Conservator of Forest's explicit concurrence.

3. It is of great importance that the effect of abandoning fire-protection and of concentrating measures such as sowings, dibblings and improvement fellings should be carefully watched and that it should be possible in future to compare the results obtained with the present state of affairs, and I am to request that all instructions issued on the subject by the Chief Conservator of Forests may be strictly attended to.

RULING REGARDING THE PAY OF IMPERIAL FOREST OFFICERS WHOSE EMOLUMENTS WERE IN EXCESS OF THE NEW TIME-SCALE PAY ON THE 6TH JANUARY 1907.

Government of India's Circular No. $\frac{34\text{-F.}}{331\text{-}2}$, *dated 3rd October* 1907, *to all Local Governments and Administrations.*

A question having arisen as to the interpretation to be placed on paragraph 5 of the Government of India's resolution No. 5-F., dated the 15th February 1907, on the subject of the introduction of the new system of pay for officers of the Imperial Forest Service, I am to invite attention to paragraph 5 of Circular No. 11-F., dated the 9th June 1905, in which the intention of the Government of India is more fully explained, and to say that when an officer's total emoluments on the 6th January 1907 were higher than they would have been under the time-scale pay, he should continue to draw those emoluments until they would have been reduced under the old scheme (for instance, by his ceasing to draw officiating allowance) or until he would be entitled to higher emoluments under the new scheme. So that, if on the 6th January 1907 an officer was officiating in a higher grade which gave him

total emoluments at a rate in excess of what he would have been entitled to under the new time-scale, he should continue to draw emoluments at that rate until, under the old system, he would have reverted to a rate of pay equal to or less than the rate admissible under the time-scale; and thereafter he should draw pay according to the time-scale without regard to what his salary would have been under the operation of the old system; that is to say an officer, having once reverted to the time-scale, would remain on that scale irrespective of the consideration that, had the graded system continued in force, he might have again acted on a higher salary at some subsequent date.